

Popular Science

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April
1928
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In This Issue:

The Amazing Story of the Two Lindberghs

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WHAT IS NEW THIS MONTH

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Keeping Abreast of the Times

Interesting questions you now will be able to answer

1. Are "two heads better than one?" (p. 64)
2. What aviator recently performed a spectacular feat in the mountain fastnesses of Quilish, Nicaragua? (p. 39)
3. How did a famous cartoonist happen to invent an automatic boat-bailing device? (p. 54)
4. Where is a new highway that runs through a skyscraper? (p. 52)
5. What will it cost you to build a newly-demonstrated set to "see by radio?" (p. 20)
6. What device has been invented to pass air, food, blankets and heating wires to the trapped crew of a sunken submarine? (p. 33)
7. Is coffee really harmful? (p. 41)
8. Who is planning a regular trans-Atlantic air passenger service to England, with a \$400 fare? (p. 54)
9. How can scientists photograph atoms? (p. 42)
10. Which of the world's largest buildings stands upon a forest of pine trees? (p. 31)
11. Just what will it cost to own and run your own plane? (p. 27)
12. What three-quarter-mile tunnel is the roomiest in the world? (p. 19)
13. Which American railroad has just installed the first automatic train-dispatching machine? (p. 37)
14. Why are sea-faring races of men pygmies? (p. 51)
15. How can you "humor" delicate plants in transplanting? (p. 66)
16. How much do mistakes of inexpert garage men cost you yearly? (p. 74)
17. Do flies leave footprints? (p. 67)
18. How high can the bucket of the world's largest power shovel swing? (p. 38)
19. Why did only one outboard motor boat cross the finish line in a recent thrilling race? (p. 25)
20. How does a prospector hunt hidden ores of precious metals by radio? (p. 45)

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A Plan that puts the \$100 Man on a Par with the Big Investor

By WALLACE AMES, Financial Editor

"OH ROY! Do stop the car here for a minute and let's take in this view."

"Four thousand miles of scenery and you're not fed up yet," said Roy Dunn to his wife, Amy, as he brought the car to a halt in the middle of the Bear Mountain Bridge.

"I'll never get fed up on a sight like this," replied Amy, as her eye swept in the magnificent panorama, first down the Hudson and then upstream. "There's the road we just came over, chiseled right out of the side of Storm King Mountain. This rivals our own Columbia River Highway. It's different, but just as awe-inspiring as anything we have out West."

"That's one of the nice things about this trip. Whether it's snow-capped Mt. Hood, California's endless stretches of groves in blossom, cloud-piercing Rockies, corn and wheat expanses of Kansas and Iowa, the Hudson cutting its channel between cliffs and palisades, or sky-scraping Manhattan itself, each sight and each scene is differently magnificent. How's that for a speech?" said Roy, with a comical gesture imitating an orator.

"How many cables does it take to hold up this bridge, Dad?" inquired 12-year-old Tom Dunn, who was more interested in engineering than in rhapsodies on scenery and who, boy-like, thought his father knew everything.

"Several thousand, I should say," and as the amiable Mr. Dunn was just as willing to talk about cables as scenery he elaborated a little on the former while Mrs. Dunn prepared to take a snap-shot of the latter.

"Take a close look at one of those cables, Tom. See how it is made up of a lot of small wires woven and twisted tightly together. You could bend and break one of the individual wires, but you couldn't break the cable itself. And the combined strength of many cables makes this bridge safe for its endless stream of automobile traffic."

"That's what is meant by the motto, 'In union there is strength.'"

"Are you ready, Amy? We better be going or we'll be pinched for blocking traffic." So the tourists continued across the bridge, wound their way along the cement road that skirts the cliffs of the East shore and that evening they were beginning their visit in the cozy home of relatives who

lived in a suburb of New York City.

Roy Dunn was a forester. For years his work had kept him in the woods of the Northwest, with only an occasional trip into Portland. Living the simple life, expenses had been low, so that Roy had saved and invested a goodly portion of his income. At the time we met the family on the Bear Mountain Bridge they were enjoying a four-months' vacation on their income from investments. Mr. and Mrs. Dunn had always wanted to "see the Country" so they had zig-zagged across the continent, camping along the way and taking in all the sights.

They had been through copper mines and oil fields, steel plants and sugar refineries, mail-order houses and automobile factories, hydro-electric developments, fruit canneries and all manner of places of interest.

The trip had been a liberal education to Roy. It had given him a clear picture of the foundation on which rests our national prosperity. He had learned the significance of our wide diversification of rich resources. He had seen how each industry, each activity, each community was like the strands in a bridge cable, how all of them woven together created a sound basis of our stability and formed the structure of our further growth.

"Well, here we are in the millionaires' capital," said Roy, half in fun, as the two families gathered in the living room after dinner. Then, turning to his brother-in-law, Paul Hammond, he ventured the thought, "I suppose every day at lunch you rub elbows with the 'big magnates' who own all those thriving industries, railroads, utilities, oil refineries and companies that we have been seeing as we motored across the country."

"You are talking to one of those 'big magnates' now," said Hammond. "I own a chunk of a good many of those enterprises myself. Companies who are helping to pay dividends on my investments are located in every state. I suppose I am interested in well over a hundred of them."

"This is a nice, comfortable place you have here, Paul, but it does not look like my idea of the home of a 'colossus of finance.' Where'd you get all the money?" Roy inquired.

"Who said anything about a lot of money?" replied (Continued on page 5)

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Full information regarding the Investors Syndicate Plan mailed upon request

34th Annual Statement of Condition, December 31, 1927

ASSETS		LIABILITIES	
Cash	560,842.78	Certificate Cash Surrender Values	\$13,336,674.09
This consists of actual cash in our vaults and deposits in various banks.		Amount of liability to owners of our Certificates for cash surrender values.	
Bonds and Securities	1,130,449.48	Contingent Liability	3,035,411.48
U. S. Government bonds and other bonds and securities at current market values.		Amount set aside to meet additions to cash surrender values.	
First Mortgage Loans	15,456,661.88	Other Accrued Liabilities	36,973.09
Consists of First Mortgages upon improved city real property only, payable in monthly installments under our amortization plan which constantly increases the margin of security. The properties securing our loans were conservatively appraised by competent real estate experts when the loans were made at approximately \$34,000,000.00.		Amount set aside for taxes, death losses and reinstatement of Certificates.	
Loans on Certificates	804,509.06	Other Current Liabilities	233,422.90
Loans to our Certificate holders secured by Certificates held by us as collateral.		Balances due on mortgages not fully funded and other current items payable.	
Real Estate	382,142.34	Total Liabilities	\$16,642,481.56
Properties carried at cost or less than cost and at values the total of which is less than current conservative appraisals.		Certificate Reserve, \$1,399,996.57	
Real Estate Contracts of Sale	746,237.36	A reserve over and above our legal liability set aside on a scientific actuarial basis as added assurance and as a guarantee of the payment of Certificates as they become due.	
Contracts secured by real estate, the collateral security being substantially in excess of the total obligations.		Capital and Surplus, \$46,019.96	
Accounts Receivable	50,165.62	Total Capital, Surplus and Reserve	2,536,509.53
Consists of Tax Certificates purchased by us on property upon which we have loans; accrued interest and other current items receivable.		Total	\$19,178,991.11
Furniture and Fixtures	42,931.57	CERTIFICATE	
Other Assets	5,051.02	We have audited the accounts pertaining to the above statement of Assets and Liabilities of the Investors Syndicate as of December 31, 1927, as shown by its books and records. Our audit included the actual verification of evidence of the possession of all its assets, together with appraisals of properties wherever such appraisals appeared necessary. We have also investigated the renewal experience of the Certificates and are of the opinion that the table of reserves adopted by the Syndicate, together with the future payments called for by the Certificates and interest accretions at the present rate will cover the discharge of all Certificates as they become due.	
\$19,178,991.11		WE HEREBY CERTIFY that, in our opinion, the above balance sheet correctly reflects the financial condition of the Investors Syndicate as of December 31, 1927. The Syndicate has complied with all of our requirements as auditors.	

STATE OF MINNESOTA)
COUNTY OF HENNEPIN)

E. E. Crabb, being first duly sworn, deposes and says that he is Vice-President and Treasurer of the Investors Syndicate, and that the foregoing financial statement is true to the best of his knowledge, information and belief.

Subscribed and sworn to before me this 10th day of January, 1928.

E. E. Crabb
Vice-President and Treasurer

(Notarial Seal) A. F. Wetter,
Notary Public, Hennepin Co., Minn.
My commission expires Sept. 26, 1934.

R. H. and LEE J. WOLFE
By *[Signature]*
Consulting Actuaries, Auditors and Accountants,
New York City.

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POPULAR SCIENCE MONTHLY
258 Fourth Ave. New York City

A Plan that puts the \$100 Man on a Par with the Big Investor

(Continued from page 4)

Paul. "Confidentially, we have just \$4,500 invested at the present time. But I told you the truth when I said we had an investment interest in many of the biggest, strongest and most prosperous concerns in the United States, at least one in every state.

"Our investments include several railroads and makers of railroad equipment; several public utilities and makers of electrical equipment; food companies, a shoe manufacturer, the automobile industry and oil; some copper mines you went through; the five-and-ten cent store business and a great variety of other lines of business."

"You seem to be sitting pretty, Paul. How do you work it?" inquired Roy, who was anxious to learn if there was a better way to invest his own money.

"It's all very simple. I just put our money in investment trust shares," Paul explained, and then he removed the veil of mystery by explaining how investment trusts enable the average man to invest on the same broad scale as the possessor of great wealth.

For the \$100 and the \$1000 Man

With a comparatively small sum, \$100 or \$1,000 or more, any individual can acquire an investment interest in a great number and wide variety of securities by the easy process of making a single investment in shares of an investment trust. No matter how limited his means, the investment trust opens to the individual the same opportunities,

dollar for dollar, that are available to millionaires and such million-dollar institutions as banks and insurance companies.

By combining the investment funds of many individuals an investment trust creates huge resources, usually running into the millions. This money is invested in a wide diversification of securities. When you buy

one share or more of an investment trust, you own your proper proportion of all the securities held by the trust. Thus, if a trust owns 10, 50, 100 or more different securities, you as a shareholder in the trust own participations in the same securities.

Making Di- versification Easy for the Small Investor

As everybody knows, the backbone of investment safety is diversification. Even with the most carefully selected investments there is always a chance that weakness or difficulty of some kind will develop in an individual security. If you had all or a considerable part of your money in one such investment it might prove costly. But when you have your money widely spread over many secu-

rities trouble in one case would be less serious.

The principle of diversification has always been understood and always been advised by investment authorities. But until the investment trust idea was developed the person of ordinary means had no practical way of diversifying his

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6½% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

Behind the Scenes Where Bonds Are Made tells how you can retire in fifteen years and have an income equal to your present living budget. This booklet can be secured by writing to Cochran and McCluer Company, 46 North Dearborn Street, Chicago, Ill.

How to Get the Things You Want tells how you can get insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Common-Sense Test of Investment Trusts suggests an easy method by which you may correctly judge the worth of any investment trust before putting your money into it. United States Fiscal Corporation, 50 Broadway, New York, will send a free copy if you request Circular CS.

The Making of a Good Investment tells how 6½% can be made on investment in First Mortgage Bonds in units of \$50, \$100, \$250, \$500 and \$1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.



These Bonds GUARANTEED

Write for facts about these United Bonds—payment of interest and principal guaranteed by United States Mortgage Bond Company—an old, well established financial institution with resources of over \$20,000,000 operating under the supervision of the State of Michigan.

This Book Tells You How to start building an income—learn to move this way. You can begin on a small initial investment, get a greater return than usual. Our book "The Habit of Success" shows the way. Write for your copy today—see coupon.



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A Plan that puts the \$100 Man on a Par with the Big Investor

(Continued from page 4)

funds. On this ground alone the investment trust is of inestimable value to the general public. But its virtue does not end there. The investment trust gives the individual investor a heretofore unattainable opportunity for extra profits in addition to normal income.

How Diversification Pays Profits

If you will take any long list of standard securities and trace back their record for a period of years you will find these things: (1) Some of them have from time to time paid extra dividends. (2) Others have recapitalized and given additional shares to their stockholders. (3) Still others, who have not given new stock outright, have granted their shareholders the right to subscribe to new stock on terms that have meant an immediate profit. (4) The market price of many securities has advanced very substantially over a period of time—advanced proportionally to higher levels than the average gain of all securities for the same period.

Extra profitable investments are not confined to a few isolated or historic cases like Ford or General Motors. Cases of unusual profits are occurring all the time. A list compiled a few months ago showed 84 securities that had advanced an average of 370% in four years. In the long list of carefully selected securities held by an investment trust there is reasonable possibility that some of them will return exceptional profits in one form or another. Such profits raise the yield to the investment trust shareholder above the normal level.

An interesting characteristic of a properly organized and soundly operated investment trust is that its earning power increases as the trust grows older. Its opportunities for profit are of the type that mature to the fullest extent only with the passage of years. This has not only been the experience in America, where the first trust was organized but a few years ago, but also British experience, after over sixty years of investment trust operation.

By referring to the forms of extra profit enumerated a few paragraphs above you will observe that they are not the sort to be expected from some sudden and sensational stock market advance. Rather, they are the result of the steady growth and development of our Nation's industries, utilities, enterprises and institutions. It is this steady growth, year after year, that contributes to the profits of investment trust shareholders.

Jim Cary's \$1,000

How an Investment Trust Benefited Him—How It Can Help You

"Now, if I had \$1,000,000 I'd . . ."

Jim Cary was a statistically-minded dreamer. Musing over some financial tables he noticed that the average price of 40 bonds had advanced 3 points within a year; and that the average price of 100 stocks was up over 20 points. His own investments did not show any such marked increase in market value.

"If I had \$1,000,000 I'd engage the best brains I could find to study values and conditions. I'd have them select a hundred or more of the world's best securities and I'd invest in all of them. Such a list would include some highly profitable investments and I'd average a nice profit on the entire lot, in addition to interest and dividends."

"I'd probably make 8% or 10%, including market profits, instead of 5% or 6% as at present—and my investments would be safer because of diversification."

"My investment counsel would help me decide when was the right time to invest, as well as what to invest in."

"But," interrupted Mrs. Cary, "right now we have only \$1,000 to invest, so why not come down to earth and figure how to invest that?"

Giving the \$1,000 Man the Millionaire's Opportunity

If he only knew it, Jim Cary could invest his \$1,000 just as scientifically as he could invest \$1,000,000.

You, too, with your \$100, \$1,000 or \$5,000 can gain all the advantages of safety and profit that are open to the millionaire. Financial Investing Co. of New York, Ltd., a British-type general investment trust, gives you this opportunity.

Financial Investing Co. has over \$3,000,000 invested in over 200 sound securities. By making one investment of any amount in Financial Investing shares, you own your pro rata part of all these securities. You gain the safety and profits of widely diversified investments under the skilled management of this investment trust.

11.32% Profit in 1927

You would have made 11.32% during 1927 if you had invested in shares of Financial Investing Co. of New York, Ltd. And you could have sold your shares at a profit which would have increased your return to over 32%.

Learn How to Make Big Profits Conservatively

It is all explained in our booklet, "The Investment Trust—from the Investor's Viewpoint," and our circular, "The Common-Sense Test of Investment Trusts." Mail the coupon and profit by reading this free literature.

UNITED STATES FISCAL CORPORATION

Managers of
Financial Investing Co. of New York, Ltd.

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Please send me, immediately, your free literature that tells how I can make big profits on conservative investments.
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Free Booklets to help Investors

The desire of investors to become more thoroughly acquainted with the advantages of First Mortgage Real Estate Bonds prompts us to offer the following booklets:

Your Money—Its Safe Investment
How First Mortgage Bonds keep your money safe. Explaining our method of doing business.

A Brief History of Guaranteed Bonds
Clearly describing the development and value of First Mortgage Real Estate Bonds as an investment.

The House Behind the Bonds
To help you judge the character of our issues by describing our personnel and method of securing offerings.

Fidelity Bonds are First Mortgages
Establishing the investment position of First Mortgage Real Estate Bonds.

Fidelity Service and the Morning Mail
Letters from people in all walks of life telling of their experiences with Fidelity Bonds.

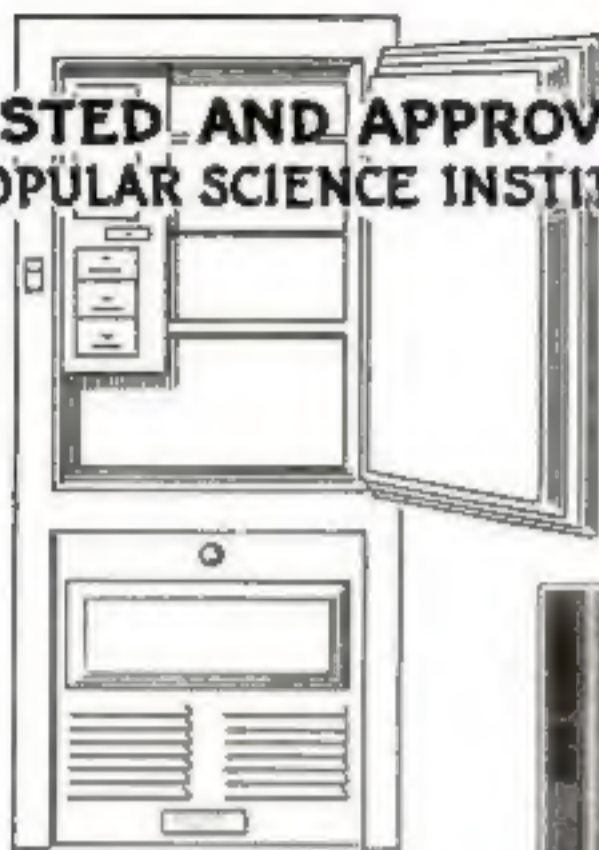
We will be glad to send at once any booklet included in the above list. Write to



660 Chemical Bldg., St. Louis
1138 New York Life Bldg., Chicago
378 Colorado Nat'l Bank Bldg., Denver

FIDELITY MEANS KEEPING FAITH

**TESTED AND APPROVED
BY POPULAR SCIENCE INSTITUTE**



This shows Prof. R. D. Merrill reading a recording thermometer outside the constant temperature room in which the Institute's refrigerator tests are conducted at New York University

HOW TO TELL A GOOD REFRIGERATOR

The Institute Tests Reveal Astonishing Facts About House- hold Refrigerators

MOST people realize that they should have a refrigerator in their home. They know that if they do not keep food cold it will spoil, and that this is a waste and expense. But they do not know that they may eat food which, although it tastes all right, may have started to spoil and eating it will make them sick.

Dr. Frederic Damrau, an able physician, was commissioned by POPULAR SCIENCE MONTHLY to make a thorough investigation of the effect on health of improper refrigeration, and an important article on this subject appears on page 22 of this issue of POPULAR SCIENCE MONTHLY.

Few people know that there is a proper temperature for the proper preservation of food. Few people know that food kept at a temperature above fifty degrees will spoil fast. Naturally, therefore, few people know what to expect from a refrigerator.

The Institute Finds Out

For over a year the Institute has been setting up machinery for the testing of refrigerators. A room has been constructed in the laboratory of the



Institute where the temperature can be raised or lowered at will. The amount of moisture in the air is regulated, and instruments installed to make records of temperature and humidity changes.

Refrigerators, both for use with ice and mechanical refrigerators, have been placed in this room and tested to find out the all important thing about a refrigerator—will it maintain a temperature inside the box low enough for the proper preservation of food—a temperature low enough to keep bacteria from multiplying, which is what makes food spoil.

Most Refrigerators in Use Are Inefficient

The tests show that the refrigerators in the average home are very inefficient. They will not keep food at a temperature low enough to keep bacteria from multiplying. Apparently, people have been content with such refrigerators because they do not know what a refrigerator should do. If they did know, they would have only an efficient refrigerator and would gladly pay its higher cost. Constant food spoilage and constant

danger from disease are a high cost to pay for a cheap refrigerator.

Good Refrigerators

The Institute has found many highly efficient refrigerators. We will gladly furnish to any reader of POPULAR SCIENCE MONTHLY a list of approved refrigerators on request.

A complete manual on refrigeration, with illustrations, has just been prepared by the engineers of the Institute. This covers the numerous points that should be considered by anyone investing in a new domestic refrigerator. Full discussion of advantages of various types, definite data on operating

cost, as well as a list of reliable makes approved after test, are contained. Several pages are devoted to precautions in installing, considerations in placement, and complete advice on care and upkeep for best results.

The price of this booklet, entitled *Refrigeration in the Home*, is twenty-five cents. It is published by the Popular Science Institute of Standards, 230 Fourth Avenue, New York, N. Y.

Popular Science Monthly GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY. THE PUBLISHERS

We waited two years to tell America about this grainless wood!

Possesses remarkable workability and uniform strength. Very dense and tough. Highly resistive to moisture. Has a very smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large, free sample.



One of the most fascinating chapters in recent industrial history is the story of Masonite Presdwood, the grainless wood board from Laurel, Mississippi.

We have waited two whole years to tell this story; waited until our product had conclusively proved in actual use that it was as good as we knew it to be.

Thus it has done, and today Masonite Presdwood is efficiently serving mankind in scores of ways.

As a lining for safety-deposit vaults, Presdwood plays a vital part in the automatic alarm system of the modern bank.

The builder of a soaring terminal tower, desiring an exceptionally fine, smooth surface, uses Presdwood—for concrete forms.

A Kansas City baker, wanting to keep his bread and rolls perfectly fresh, packs them in Presdwood boxes.

A Nebraska farmer sits down in the evening to enjoy his new radio, and the tension board in back of the loud speaker is Presdwood.

Down on the lower Mississippi, a steamboat paneled inside and outside with more Presdwood.

Out in Hollywood, Masonite Presdwood again—thousands of feet of it used in making movies.

New uses discovered almost every day

Masonite Presdwood uses range from doll houses to bridges and flumes. Advertising signs along the highways, campers' tables, a safety wheel for swimming pools, barbecue stands, theater props, starch trays for candy manufacturers—all these, and many other things of Masonite Presdwood.

In planing mills and woodworking plants, as in so many other lines of industry, the demand for Presdwood is increasing by leaps and bounds. Breakfast

nooks are made of it; so are kitchen cabinets, china closets and shelving. Not forgetting counters, show cases, display booths, work-bench tops!

Masonite Presdwood is actually a better product than Nature's own material; better in four ways. It is grainless, has greater moisture resistance, is much denser, and is far tougher! Yet it contains no foreign substance, not even a chemical binder. It is genuine wood—and nothing else—wood torn apart and put together again.

Fresh, clean chips are shot from guns at a velocity of about 4,000 feet per second. The long fibres thus produced are packed into hydraulic flat bed presses, and subjected to hundreds of tons of pressure. This super-tough and sturdy material, entirely free from knots and other defects, is then cut by automatic machines into boards four feet wide and twelve feet long.

Advantages of Masonite Presdwood

Masonite Presdwood won't crack, check, split or splinter. It is highly resistive to wear and moisture, and shows minimum contraction and expansion.

It can be used on any woodworking machinery: planer, sander, shaper; and because it contains no grit or foreign substance it does not damage tools.

Comes in convenient size—four feet wide by twelve feet long. Requires no paint for protection. Yet takes any finish: lacquer, paint, stain or varnish.

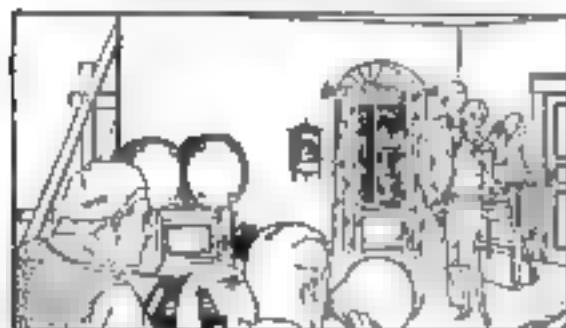
Why not experiment with Masonite Presdwood yourself? Large free sample will be forwarded promptly on request. Send for it today.

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Sales Offices: Dept. 1248, 111 W. Washington Street
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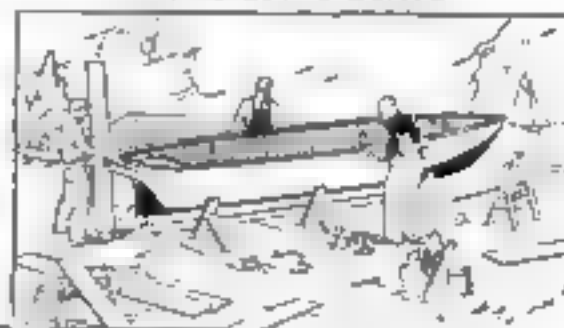
IN MAKING MOVIES

Laurel, Mississippi



Masonite
PRESWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION

IN BUILDING BOATS



Our Readers Say—



Can Radio Harm Us?

I READ the other day of two different experiments in which it was found that radio waves affect the human body. In one case Professor McLennan of the University of Toronto claimed he discovered that long radio waves raise the body temperature and so might be used to kill disease. In the other case, workmen in the General Electric Company were found to suffer from high blood pressure after working with a high frequency tube used for short waves.

"I have often thought about the many waves of different frequency from broadcasting stations that are constantly going through our houses and passing through our bodies, and have wondered if they have any effect upon us. Perhaps some of your readers know the answer to this."—L. M. C., Buffalo, N. Y.



Give the Man a Chance

"YOU'RE way behind the times in this 'back seat driving' argument," pens D. B. M., from Newark, N. J. "Time was, to be sure, when women drove from the back seat, and were dangerous. Now they drive from the front seat and are murderous."

"If you don't believe this, witness the appalling increase in bent senkers and broken collar bones."

"May I quote from the letter of Mrs. L. B. which you published last month:

"Why must the wife sit in the back seat, anyway?" she asked.

"The answer is, she doesn't. Once driving was my favorite sport, but now I'm lucky if I'm allowed to do as much as let down the emergency brake. Ask others."

"Again, Mrs. L. B. said: 'Since learning to drive I have found that what looks like an unavoidable smash from the back seat does not remotely suggest one to the driver.'"

"She said it! I know a woman driver who got her front wheels on the railroad track with the train coming. And what did she do? Began fishing in her bag for a compact!"

"Yours for a square deal for the man."

The War Is On

"YOUR recent article, 'Can You Say What You Mean?' by Professor Harper, of Princeton University, is an interesting one—interesting chiefly because of its numerous solecisms and inaccuracies."



"He says 'I rented a house to him' is wrong. As a matter of fact, it is perfectly good English—see Webster. 'I built a home' and 'He was rushed to the hospital' are also correct."

"Clubmen and others of that ilk is wrong, not for the reason given by Professor Harper, but because the pronoun should be in the plural. 'Ilk' is legitimately used in this connection."

"The majority of the eggs proved rotten' is set down as wrong simply because the word

'majority' is 'pompous,' whereas the sentence is grammatically wrong in the omission of the verb 'to be.'"

"When a man undertakes to lead others, he should see that he does not himself stumble."—C. H., Los Angeles, Calif.

Ten Years Ago—

"I LIKE your magazine in some ways very much, but frankly I do not like the amount of space given to the latest war material. I find an article headed, 'Getting Ready for the Next War,' so it seems the howl ten years ago about 'a war to end war' has turned out to be nothing but a plain lie, as a lot of people thought it was. Why not have some articles regarding world peace?"—K. J. D., Rockport, Tex.

"Your article 'Battleships on Wheels' brought me surprise and delight. It certainly recalls the old days, for I was radio operator on the U. S. S. *Penacola*, which you mention. The story is interesting, because I have often wanted to know the events that led up to our getting a pair of those important naval guns over safely. I remember that we heard of the first ship being torpedoed, and I had always been under the impression that the U. S. S. *Penacola* got the first pair of guns over safely. The U. S. S. *Bath* was in the same convoy, but on arriving in port she had some trouble and we started off from Brest to St. Nazaire without convoy and at night. That was a trick which helped St. Plunkett get his big babies quicker."—L. D. S., Albany, N. Y.

Why Not Paint the Town?

"EVERY time I read of furniture building in your Home Workshop, I want to start right in and make some of it, it is so interesting. I am a woman, but am a sort of craftsman in a small way. The article on lacquer painting was a great help, as it explained the things that it wouldn't do or would do under certain conditions. I was one of the first to use lacquer in this city and had to work it out with few directions, but now that I understand it I paint everything in sight; in fact, the only way to keep a thing from being lacquered is to move it out of the house. Tables, chairs, picture frames, boxes—everything and anything which needs repairing or improving gets a coat of it. I am crazy about it."—G. E. B., Quincy, Ill.



Page Mr. Paus

"YOUR front cover pages ring the bell every month. But I ask you, in all fairness, did Mr. Paus, the artist, ever see a lumberjack wearing bright green overalls? Or a telescope painted yellow and purple?"—L. B. J., Salem, Ore.

"The February cover showing a wrecking crew lifting a locomotive certainly was lifelike. When I worked on a railroad I saw a wreck almost exactly like the picture."—W. H., Moscow, O.

"I hang some of your fine cover pictures on the bare walls of my attic workshop. Believe me, it is some improvement."—S. N. B., Trenton, N. J.

Where Germs Lurk

"AS A member of the POPULAR SCIENCE MONTHLY INSTITUTE, I wish to call your attention to the extremely poor sanitary conditions found in public places."

"Cosmeticians, when giving a scalp massage and combing the hair, do not as a rule sterilize their hands or combs, and the barber seldom, if ever, sterilizes his razor or the contaminated tweezers that he is constantly using. Visiting nurses who examine school children rarely disinfect their hands after examining teeth or throat—a very easy way to spread infection among large numbers of children."

In respect to the soda fountains, it has been found that a mere rinsing of spoons, knives, forks, etc., in soapy warm water or even hot water back of the counter does not kill the millions of pathogenic organisms found on them. And since they are wiped dry with the same towel, one spoon infected may infect others, so spreading the disease to a healthy person who is looking forward to a little pleasure in a nice sandwich or a dish of ice cream."—J. O. G., Portland, Ore.



Pleasure That Lasts

"WHEN you gave the specifications for a one-tube radio set, I built several of them which gave good results. I then added two stages of audio-frequency amplification. This set has been in continuous use for three years without any repairs or replacements except batteries. Visitors say that they can get no such clear, natural reproduction on their sets, which cost two and three times as much. I must congratulate you on the very excellent set you designed."—A. E. S., Croglan, N. Y.

"As soon as I can scrape the parts together I am going to build your new electric set. Believe me, if it is anything like the other receivers you have told how to build, it is going to be a knockout."—K. D. N., Lincoln, Neb.



Courage

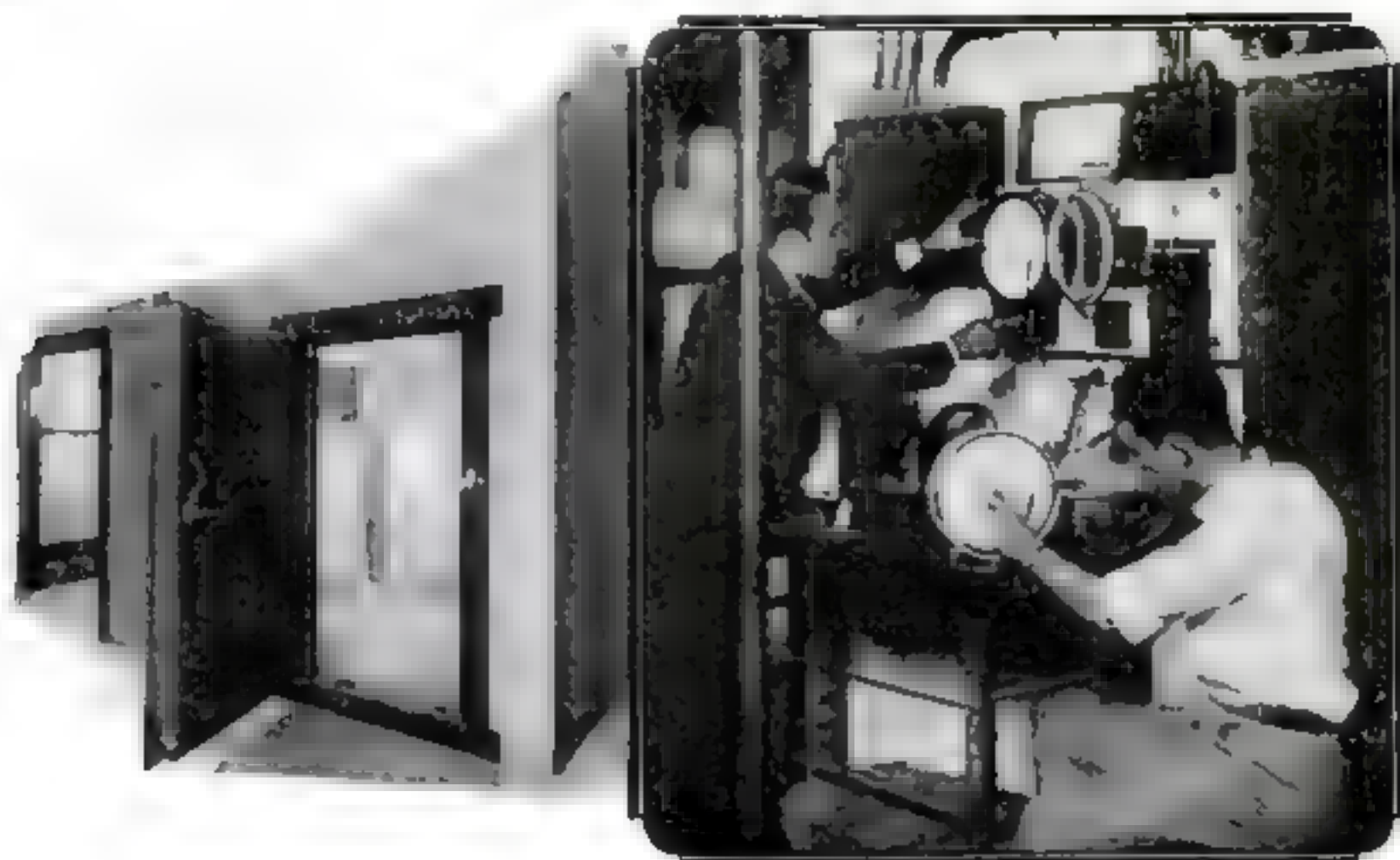
THIRTY FIVE years ago an accidental shot in the back paralyzed him from the waist down. But he could move his hands! He studied draftsmanship, and became an expert.

Today he does a business with patent attorneys which runs into a yearly income of five figures.

Intensely interested in inventions, he has developed more than fourteen for his own use exclusively—including a hand-operated automobile that substitutes for a pair of helpless legs.

This much we gleaned of the life of F. H. B., of Dallas, Texas, from a note of appreciation which arrived in the mail the other day. And then, this last paragraph:

"I don't know whether it would have been possible for me to have lived all this time if it hadn't been for POPULAR SCIENCE MONTHLY, which interests me more than any publication in the world."



Engineers of Popular Science Institute

insure accuracy of their tests of electric refrigerators

by using *Tycos Recording Thermometers*

Tycos for the Home

Tycos Office Thermometers

An aid in promoting human efficiency

Tycos Bath Thermometers

To enable you to get the most good from your bath.

Tycos Home Set

Bake Oven Thermometer Candy Thermometer Sugar Meter The secret of accurate results in cooking

Tycos Wall Thermometers

To help you maintain a temperature in your house conducive to good health.

Tycos Quality Compasses

To show you the right way in unfamiliar country

Tycos Fever Thermometers

A necessity in every home.

Tycos Stormguards

Forecasts the weather twenty-four hours ahead with dependable accuracy

Tycos Hygrometer

To enable you to keep the humidity of the atmosphere in your home correct at all times.

Tycos for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.

Tycos Urinalysis Glucose.

Tycos Fever Thermometers.

Your dealer will show them to you.
Ask us, on a postal, for booklets
on any of the above.

Bulletins on Request

TYCOS Instruments have been selected by the engineers of New York University to use in establishing the standard tests they have developed for Electric Refrigerators.

These Engineers know that the *Tycos* Equipment on the instrument board of their constant temperature room insures them of an accurate check on the tests they are making that the continuous records of temperature will be automatically accurate to a fraction of a degree.

And down in the sub-cellar of the Sage Engineering Laboratories of New York University are dozens of other *Tycos* Instruments working day and night in what a famous mechanical engineer has called "the finest model furnace room in America."

Where super-accurate indicating, recording or controlling of temperature is required you will find *Tycos* Instruments whether in the silent laboratories of science or the roaring mills where steel is fashioned for man's use.

Tycos Instruments are the Sixth Sense of Industry. They are saving labor costs, eliminating loss through spoilage, and insuring uniformity of quality in all branches of industry where the indicating, recording and controlling of heat is required.

If you use heat treating processes in your plant there are types and styles of instruments in the *Tycos* line of 8,000 varieties that will help you. Informative literature on any type of instrument will be sent you, promptly, on request. Our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

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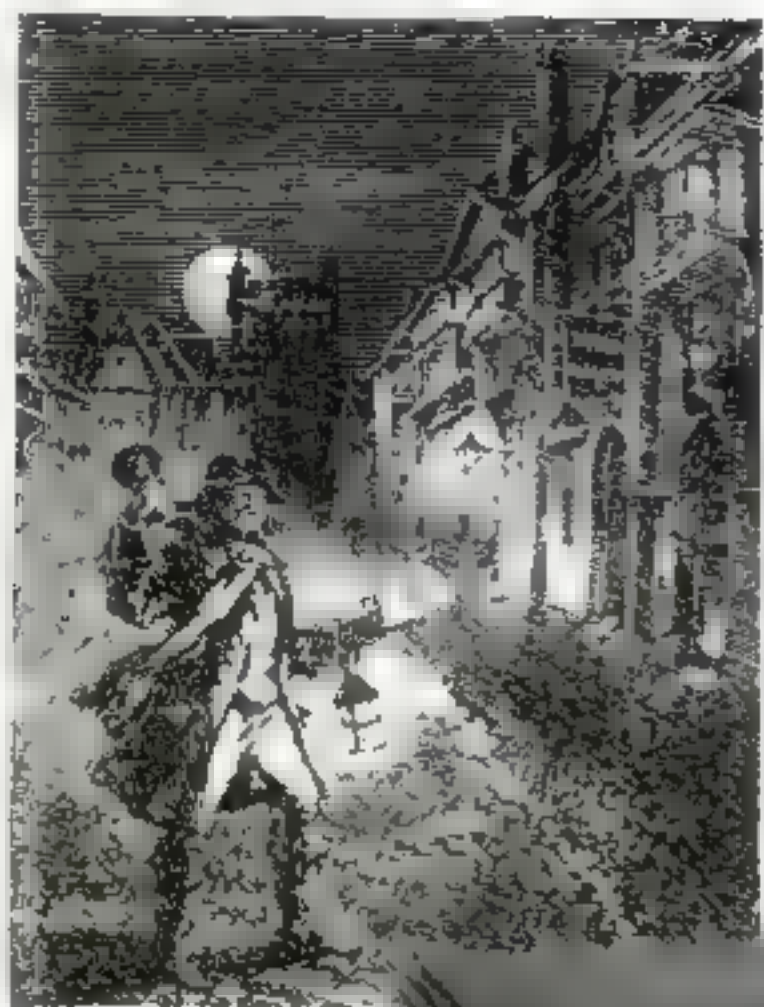
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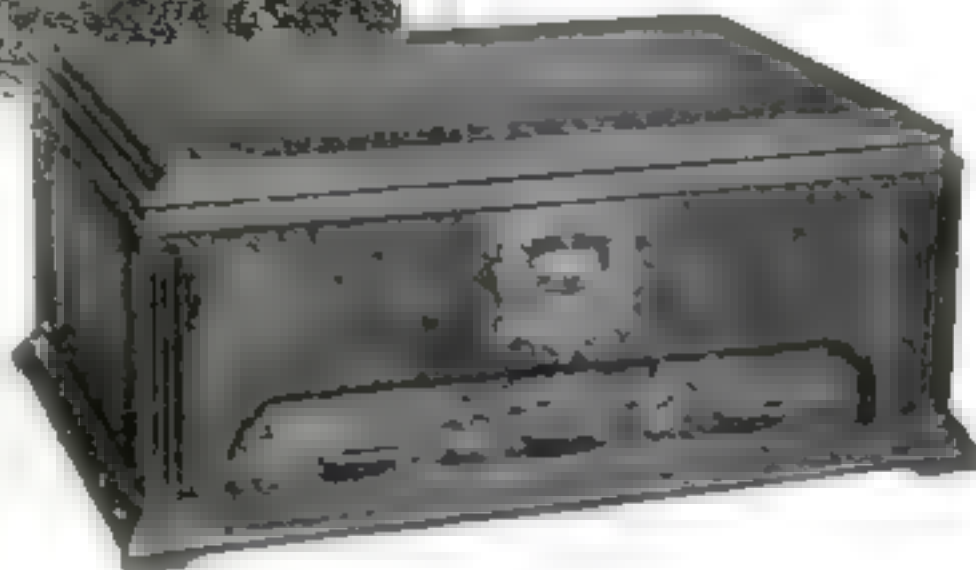


THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY
Tycos Temperature Instruments
INDICATING ~ RECORDING ~ CONTROLLING



Before the speaker
was...
of...
the...
officials called a 'Color.'

Get it *Better* with a Grebe



Born with a heritage of 19 years of outstanding radio leadership, endowed with tonal beauty, selectivity and ease of operation, the Grebe Synchrophase A-C Six is presented—the newest member of a famous family.

This receiver uses A-C (alternating current) tubes and entirely eliminates batteries and socket power units. Just plug into the light socket and listen.

Incomparable range and selectivity—single illuminated dial—freedom from A-C hum—maximum volume without distortion and other new Grebe improvements enable

you to get better local and distance reception.

The Grebe Synchrophase A-C Six is truly the battery-less set for which you have been waiting. Hear it today. Then you will have a complete demonstration of what expert painstaking radio engineering can accomplish.



Grebe Natural Speaker (illustrated), \$35; Grebe Speaker No. 1750, \$17.50. Where alternating current is not available, the Synchrophase Seven, \$135; or the Synchrophase Five, \$95. You will be interested in Booklet P which fully explains the new Grebe A-C Six. Sent upon request.

GREBE SYNCHROPHASE A-C Six RADIO

A. H. Grebe & Company, Inc., 109 West 57th Street, New York City
 Factory: Richmond Hill, N. Y. Western Branch: 443 So. San Pedro Street, Los Angeles, California
 Makers of quality radio since 1909



Lindbergh—How He Does It; An Amazing Revelation

HERE are answered the questions everybody has been asking in recent months—How does “Lindy” always succeed; always fly where he says he will, when he says he will? It is a fascinating story of the two sides of the famous aviator

By CALEB JOHNSON



The Colonel

Charles A. Lindbergh at a formal public function, being a percentage successfully, not because he enjoys it, but because it is the thing expected of him and so he has learned to do it

“SLIM” LINDBERGH, an unknown aviator, took off from Roosevelt Field on the morning of May 20, 1927, and landed at Paris the following night. Colonel Charles A. Lindbergh came back from Paris on the *Memphis* a world-famous hero.

Everybody has been reading about Colonel Lindbergh ever since. He has done things nobody ever did before. He has made forty-eight flights in the United States, one to every state, and always arrived precisely on schedule. He has flown to Mexico, to the capitals of Central America, to Panama, to Colombia, to Venezuela and to the West Indies, again always on schedule.

And as “ambassador without portfolio” he has displayed a poise, a sense of modesty, a facility in saying and doing the right thing at the right time which have made some wonder whether he was not something more than human. Not a single break. I set out to discover the secret of Lindbergh’s success as a flyer and as an unofficial diplomat and public character. And I found—Slim.

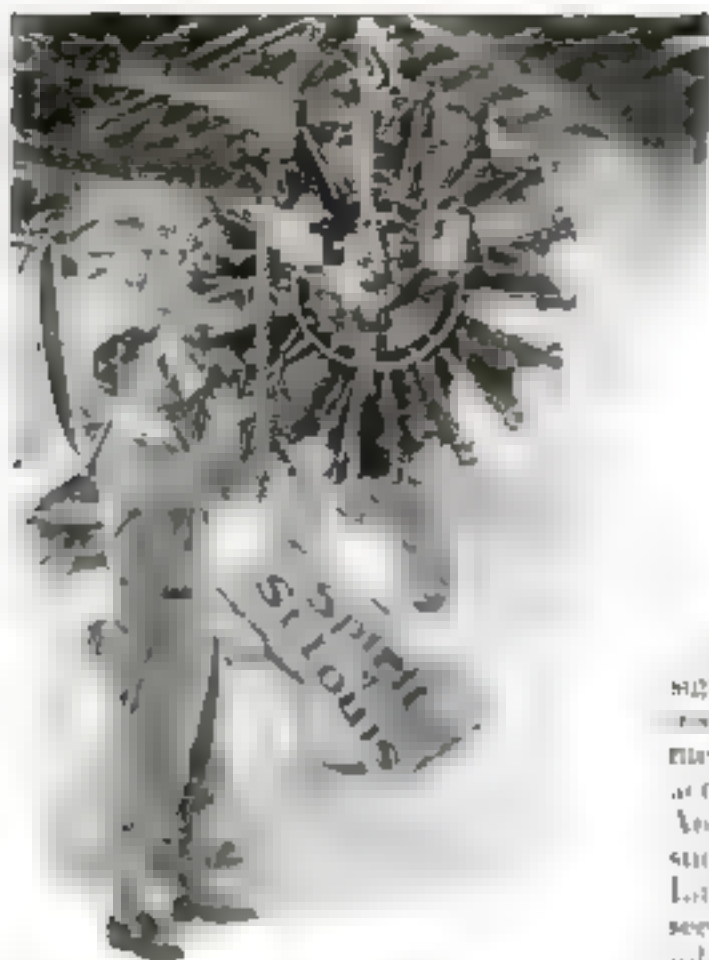
BACK of the Colonel, always Slim. Standing off and looking at himself, as it were. Slim Lindbergh, determining in advance how Colonel Lindbergh ought to act, talk, look, in any given set of circumstances. And guiding Colonel Lindbergh’s hand on the controls of the *Spirit of St. Louis* was Slim Lindbergh, airman, with everything figured out in advance—how to act, what to do, in any flying emergency. In the air, indeed, Colonel Lindbergh disappears. It is Slim Lindbergh alone up there in the plane.

Do I make it clear? Let me illustrate with a story Dick Blythe told me. Dick was Lindbergh’s adviser on public relations after the return from France; they



“Slim”

Charles A. Lindbergh, world’s matchless genius of flight—the real Lindbergh. With flying togs put over evening attire for a quick flight, he will in a moment be “where he lives,” in the air



While "Slim" Lindbergh rests at Hahnemann Heights, N. J., a mechanic overhauls his plane.

lived together, ate together, sometimes had to sleep together. One rare evening when there were no engagements they thought of going to the theater together.

"Hold on a minute," said Slim. "We've got to look at Colonel Lindbergh. What ought the Colonel to do about this?"

"What do you mean?" asked Blythe puzzled.

"Why, it's plain enough," replied Slim. "If I go to the theater as somebody's guest, or as one of a special party, there's no harm done. But if I go on my own initiative that's my deliberate choice of a show. Somebody's going to make capital out of it. 'Lindy picked the . . . as the best show in New York.' Get me? Slim can do as he pleases, but Colonel Lindbergh has got to watch his step."

The incident contains the whole secret of Lindbergh's success, both as a flyer and as an unofficial diplomat. It boils down to one word—forethought.

That was the answer I got, in one form or another, from everyone I hunted up who could throw light on the mystery of Lindbergh. Pilots and mechanics who had flown with him, who had serviced his plane and his engine, been with him as cadets at Kelly Field in Texas or gossiped with him in the airmen's favorite occupation of "ground flying"; men who had been on shipboard with him, who have known him intimately in the year since he flew to Paris, who have been his advisers in many ways—all told me substantially the same thing.

FORESIGHT—preparedness—constant study and thought—always looking ahead, to be ready for any situation—any emergency—that's Slim.

Before he took off from Washington for his recent Latin-American flight, he had studied maps of every country he planned to visit, he knew about every landing field available; and by hours at the Navy Hydrographic Office he had in-

formed himself of prevailing weather conditions, probable future conditions and even possible conditions aloft and on the ground and in between. He had obtained to take with him charts with all this data, prepared by Navy experts.

Moreover, he had seen to it that his plane and engine would be properly cared for at the several ports of call. The United States Marines, the Army and Navy and the Wright Company, manufacturers of his engine, all cooperated with Latin-American air experts in providing the mechanical care upon which Lindbergh knows successful flight depends.

That's one picture of Lindbergh's foresight. Add to it a personality which is instantly appealing and attractive, to men as well as to women, and you have accounted for all of Lindbergh's successes. And in hunting for the secret of these successes, I found another picture of Lindbergh, one which the public has not seen at all—Slim Lindbergh, practical joker.

There's a hint of it in *W's*, Lindbergh's book, where Lindy tells of a certain episode involving a sergeant, a skunk and



Map of Lindbergh's air visit to southern neighbors.

the enforced ventilation of the barracks. He doesn't confess, in his book, but Ted Moseley, who hasn't been heard from since he left Daytona Beach last January to fly north with films of President Coolidge's visit to Havana, put that episode entirely up to Slim.

On the *Memphis*, coming back from Paris, Slim rigged up a gadget to work a shower bath from the outside. He tried it first on a newspaperman who, fully clothed and expecting to get a "human interest" item out of the "invention" Slim asked him to inspect, stepped under the shower and got literally "all wet" when Lindbergh pulled the string. Officers in full uniform, hearing the commotion, seeking its source, were enjoying a

good laugh at the newspaperman's expense when Slim pulled the string again.

An irrepressible boy—that's one side of Slim. A boy whose idea of fun takes such forms as tying Dick Blythe's toe to the bedpost with a necktie, after Dick had gone to sleep, and having himself called early so as to be sure to be on hand when Dick, trying to jump out of bed, landed on his head. Go down to one of the great air fields on Long Island and do some ground flying with "Casey" Jones, "Merry" Merrill and the other airmen if you want to hear of pitchers of cracked ice emptied into other fellows' beds, glasses of water carefully spilled on the seats of chairs in which high-batted and dignified exponents of aviation were about to sit down—and did.

YET Slim, according to the men who knew him in the old "barnstorming" days and at Kelly Field, never was a "mixer." A good enough sport, when with the crowd, but seldom with the crowd by preference. He doesn't drink, and he never exhibited the interest in girls which most young men of his age have. "They interfere with a fellow's work," he told a friend. And Slim's work is flying.

"He'd land on the field and say howdy to any other flyers that happened to be there, get the necessary information about gas and supplies and then just flock by himself," said one who remembered Slim as a barnstormer.

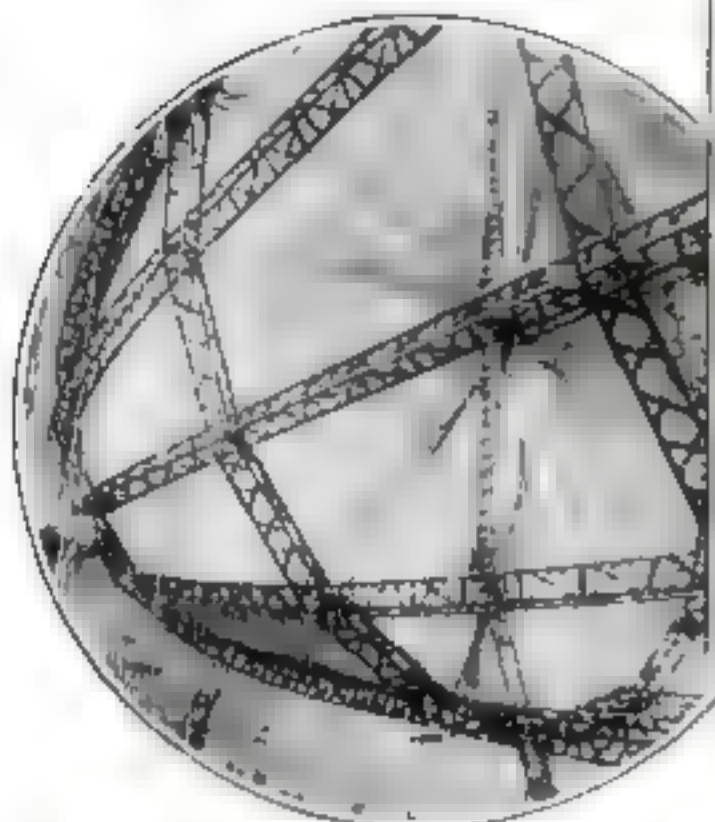
He followed the same habit at Kelly, Ted Moseley said. "A lone bird, always busy, but always by himself when possible. He always had some problem working out in his mind. He had to be busy all the time, and would tinker with his plane all day, when he wasn't flying. Talking to nobody except about things concerned with flying. When he did join the bunch, as often as not a practical joke was Slim's way of relieving his mental tension."

HE WORKS that way today. Studying all the time, thinking out problems of flying. It isn't a sport, a pastime, or merely a means of livehood with him, it is his whole life. Everything else bores him. He goes through with formal functions, official visits to foreign countries, because (Continued on page 124)



Col. Lindbergh (the tall man in the foreground wearing a soft hat) looks over his plane shortly before hopping off for Latin America.

From the Camera's Panorama



Committee Surveys City in Plane to Pick Airport Site

New York's advisory airport committee recently flew over the metropolitan area from Mitchell Field seeking landing field sites closer to the city than those on Long Island and New Jersey

Largest Dirigible's First Gas Bag

Fifteen more bags like this, shown in the photo of the R 100 being built in England for trans-Atlantic service, will lift the world's largest ship. The ship's total gas capacity is 5,000,000 cubic feet.



Edison at Ford's Show

Thomas A. Edison left stacks behind his friend Henry Ford at the recent Ford industrial show in New York City, both watching operation of a well-known machine, one of several mechanisms designed to make the new Ford car.

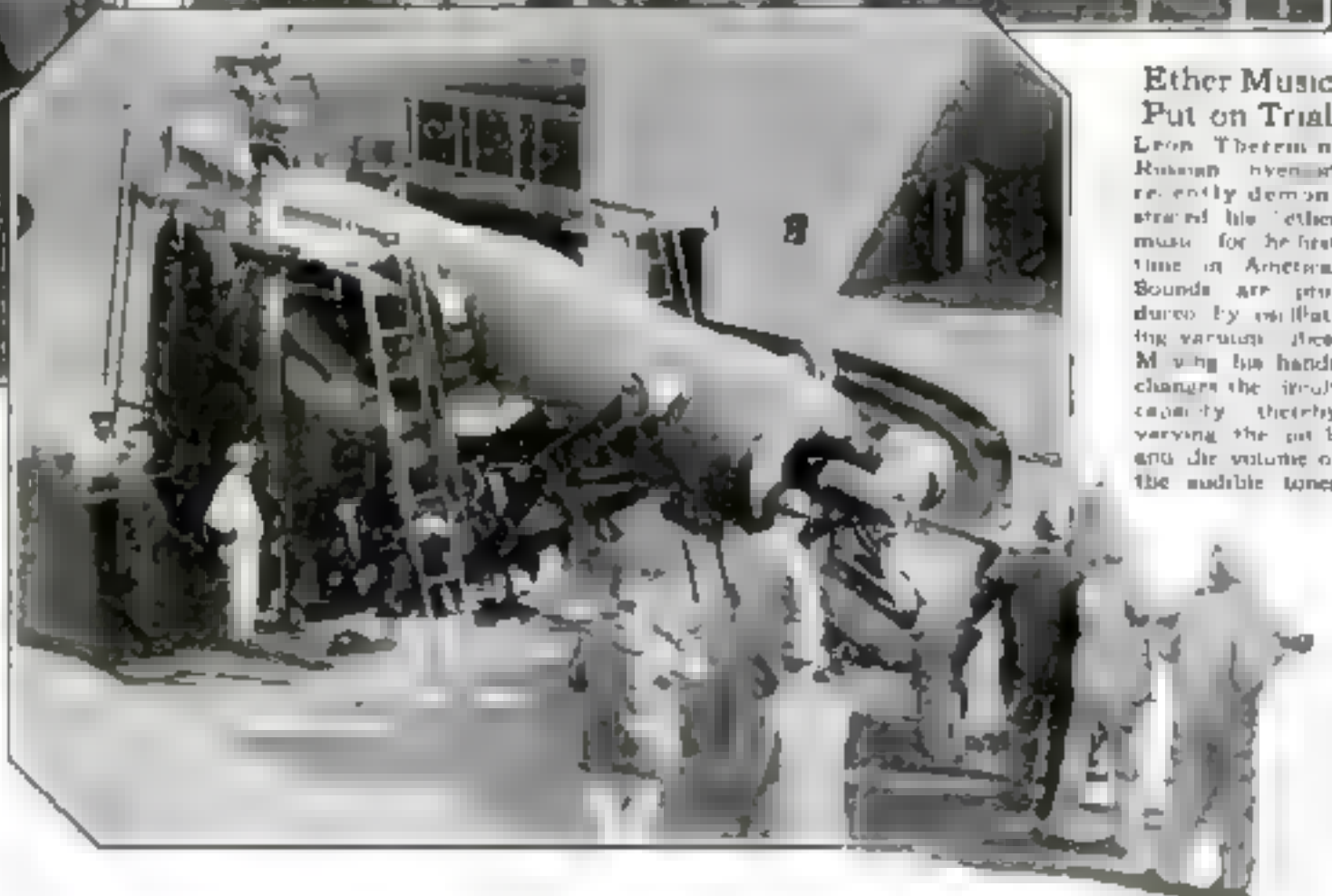
New 870 Pound Shell

Equipped with timing gears, these new type high explosive projectiles are seen being tested by the Navy in 12-inch guns at Fort Hancock, Sandy Hook, N. J., where they hit targets eight miles off. A shot takes 285 pounds of powder.



Ether Music Put on Trial

Leon Theremin, Russian inventor, recently demonstrated his 'ether music' for the first time in America. Sounds are produced by twirling various discs. Moving his hands changes the interval capacity, thereby varying the pitch and the volume of the audible tones.





Dinnie stood like a rock. "Get out," he said to Bonner, "before I throw ye out!"

"The Make Must Go On"

A Real Story of a Dramatic Day Amid Flaming Blasts in the Gas Works

By F. N. LITTEN *Illustrated by C. B. FALLS*

BENEATH the grimy slate roof of the Twenty-third Street Works, the gas machines roared as the air blast thundered through them. The blast, driving up through the machines, fanned the red coke within to white heat, and flamed out the stack. Then, as the flame died, the run began transforming coke, steam and fire into a genie, greater than Aladdin's lamp could summon, who, invisible, served a million homes. Gas, the product of a never-ending cycle, blast and run. Gas, rushing through mains below ground to the storage holder towering high above the river, waiting there to feed the city.

In the Twenty-third Street Works were seven monster gas machines, upright cylinders, brick-lined, reaching from basement to the steel control floor twenty feet above. Numbered from one to seven, the giants were good for five million feet, a mountain range of gas each day, but at a price. The price, clean fires, a bed of fuel unchoked by ash or clinker.

On the control floor stood the Works "super," peering through the open charging door of Number One machine into the blinding glare of her fuel bed. Old in years and experience was Dinnie Maroney, twenty years a super-

tendent. Too old? Gossip said that the new chief engineer had hinted the old man's grip was growing slack. No slack in that voice, though, as he wheeled upon the man beside him.

"Choked with clinker! An' the gas goin' out o' the holder as fast as we kin make more. Ye let the gang move on an' lave ye with a dirty fire. I warn ye, Steve, no gas-maker stays on my payroll long, who don't mind his fire."

Steve Bonner glared, spat violently on the hot floor plates. His head went forward in a savage gesture, then he hesitated, his eyes turned to where Dan Hunt, the young works assistant, stood by the gas-maker's desk, intent on the log sheet.

"Warn your young college lad about it, then." Steve's laugh was ugly, and the sweaty woolen shirt sleeve raised to wipe his face only half concealed a sneer.

The old man drew up, a cold light in his blue eyes.

"Don't stand there huntin' from the wrong side of your mouth, Steve Bonner. What's Hunt to do with this? Talk plain."

"I'll talk plain, Maroney," the gas-maker answered. "This kid, not me, bossed the cleaning gang on Number One this mornin'. That's what he's got to do with it." Again he laughed.

MORE than two centuries ago an Irish experimenter, Dr. John Clayton, made a torch by filling a bladder with inflammable gas obtained from coal, pricking the bladder, and lighting the jet of escaping gas. Since then the manufacture of illuminating gas has revolutionized lighting and heating throughout the world. The author of this story has himself worked in a gas plant. In relating its dramatic incidents he gives us a vivid, accurate picture of modern gas-making.—The Editor.



With a gasp, Dan Hunt sank to his knees. The foreman's eyes descended swiftly and the shadow collapsed. The cruel face of Bonner stared up sightless

harshly, then turned away, muttering something about "smart kids an' old cripples." But Dinnie failed to hear it. His swift, bent shuffle was carrying him to the desk where his assistant still pored over the gas-maker's log.

The old man halted at Dan's side.

"**H**UNT, I'm told ye closed up Number One machine an' left her full o' clinkers."

The color rose in Dan Hunt's face. He shot a glance across the floor at Bonner, who was piloting a coke-filled buggy into place

beside the charging door. Then slowly his gaze, troubled, met Maroney's hard blue eyes.

"We're short of gas, sir," his defense began. "The gang was on Steve's machine two hours." Then, fearing he might say too much, "I thought she'd go through," he ended lamely, and waited, conscious of stern condemnation in the other's silence.

The superintendent let the pause grow wide. At length he said:

"We've a sayin' in the gas works, Hunt, ye've heard it: *the make must go on.* You're an engineer and should know that a dirty fire will give no gas. It lets no air blast through, an' when

the run goes on, the machine is cold—she'll not take the steam. So 'the make' suffers." He looked at the young man witheringly. "I told ye two hours for the cleaning of a fire was aplenty, but thought ye'd use a pinch of judgment with the knowledge."

Dan shifted. He moistened his lips, opened them, as though to answer, then thought better of it. He seemed to hear Steve Bonner's threats of that morning sounding in his ears again. Perhaps old Dunnie should be told, but then trouble would break loose. Was it the thing to do? At any rate, he'd take the blame while he thought matters over. He hoped the boss hadn't caught the whiskey on Steve Bonner's breath, though. Again he moved uneasily and started to reply. At that moment he saw Tommy Cullen charging up the run stairway from the basement, and heard his excited cry:

"South Station's on the wire. Switchin' crew just dumped a string of coke cars off the trestle, busted the big water main and shut her down! We got to feed the whole West Side!"

CULLEN'S glance questioned Maroney, but the old man, apparently unmoved, stared past him down the stairway.

"You understand?" The valve man's voice rose impatiently. "She's down, I say—her storage holder's about empty, too. We got to turn gas into her mains by noon—she's down!"

The superintendent swung back quickly.

"Your news is over had to bear the tell n' of it three times." Then: "Telephone South Station we'll be ready to pick their pressure up at noon."

Again the valve man interrupted.

"We got little gas in the river holder—less than a million on the last hour's reading."

Once more a chilly glitter in Maroney's eyes. Cullen fled, but the superintendent's words chased him down the stair:

"Tend your valve room, Thomas Cullen. The gas-makin' floor'll watch the make."

MARONEY studied the log sheet a moment, then turned to Dan.

"Tell Steve, more down-runs to work the clinker off her linings. 'Tis no lie that we're short of gas—desp'rit short. Watch them things ' he indicated the pyrometers. "you'll know if she's pickin' up the heat." He set a cautious foot upon the stairs. "I'll go below and see that Number Two's cleaned right. We can't chance another clocked machine this day."

Dan watched his halting descent with a sense of bafflement. A tough angle, this was. To come on duty find Steve Bonner in the blast trench stupid drunk, the fire gang waiting idle, that was bad. To direct the job of cleaning Bonner's fires and find you'd made a bubble of it, that was worse. But—and beside this last all else faded to an ugly background—the superlative of trouble lay in Bonner's thick response that morning as he marched through the basement after Dan Hunt had shaken him to his feet:

"Can me? You ain't got the nerve. Nor Maroney—the old flannel mouth! When I go, the gang goes with me. We're ready. Tel. the old man—just start something, kid, we'll finish it—we're all together, waiting for the break."

A walk-out—the plant closed—South Station down, too. Why, it would mean half the city, a million people without gas. Babies, sick folks, suffering; cold, hunger, industry at a standstill. The significance of it bore down with crushing force. A sudden real-

ization of responsibility—his responsibility—sent a cold thrill through him. He understood now what lay behind old Dunnie's oft-repeated sh-gan. Dan repeated it underneath his breath—"the make must go on"—and fear ebbed slowly, to be replaced by growing, steadfast courage. He moved across the floor to where Bonner now watched the hunkies scooping coke into the charging door.

"Steve," he said firmly, "the boss says try some extra down-runs." His voice seemed to affect the gas-maker not at all. Punctuated by the scraping clang of scoops, Bonner sang in a thick growl:

"A flannel-mouth Turk in the gas-house stork,

Bar down, terriers, down!

His back near broke a-shovellin' coke,

Down, terriers, down—"

The men began to grin. One bandy-legged worker set his scoop against the floor and leaned wily on the handle to enjoy the melody. Dan stepped closer and the song broke off.

"DOWN-RUNS, eh?" said Bonner, and smiled. His eyes were shot with tiny red veins and Dan noted that tremors shook the heavy hands. "I need a drink, then I'll make 'em all down-runs." He turned suddenly. "Bear down on them scoops, ye polacks," and as the shovels rang again, he walked heavily away from Hunt and disappeared behind the cylinder of the super-heater.

When he returned the charge was finished. The helper swung the donelike cap in place, sealing off the purple tongues of flame that licked it hungrily. And as Bonner spun the blast valves open, with a leaping roar a red flame pillar burst out through the super-heated throat and up the stack.

The gas-maker motioned Hunt.

"The old man always fires you if you take a drink," he grunted knowingly. "Not Steve Bonner, though. I got the sign on him. He dassent . . . And so South's shut down? This 'ud be the time to make things good—we're sick of bein' handled like a chain gang here." He leaned closer and Dan caught the acrid pungence of raw alcohol. "I guess I'll have 'em all go home at noon."

The boy caught his breath in, desperately. His eyes met Bonner's. Then a quick inspiration.

He laughed scornfully.

"You said it, Steve! Have 'em go home. You go too. South Station's gas-makers are all idle now she's down. One of 'em can bring this machine back. It's a cinch you can't—and we need the gas."

Bonner's face darkened. Dan saw his shot had scored.

"We'll picket this works. The man that comes in after we walk out'll get his—he won't make no gas for you." Then a lowering, suspicious stare. "Can't bring her back?" he muttered. "I could show you something."

Dan forced a smile again.

"YOU better quit now, Steve. The boss can put a good man in your place on Number One."

A conflict of emotions played over Bonner's sodden face. Hate, jealous pride, revenge. Then slowly his expression changed to crafty cunning.

"No, I'll stay with it, boy," he said. He swung round to his machine, roared at his helper, "Change to a down-run!" and Dan Hunt felt his muscles that had

(Continued on page 138)



On the control floor stood the "super," peering through the open charging door of Number One machine into the blinding glare

Tunnel Built, Then Sunk in Bay



Golden Gate Tube Laid in Sections In Unparalleled Engineering Exploit

By H. H. DUNN

EARLY this summer Californians will celebrate the opening of the most remarkable underwater highway, in many respects, that engineers have ever attempted. It is the \$4,300,000 Oakland-Alameda Estuary Tube, running nearly three-fourths of a mile under old San Antonio Creek, an arm of San Francisco Bay, and replacing the Webster Street Bridge, which now links the two cities.

The spectacular and daring achievement marks a distinct advance in tunnel engineering, first because it is the roomiest tube of its kind in the world, and second because of its novel construction. Instead of being driven beneath the bed of the waterway, as was the great Holland tunnel under the Hudson River (described in last January's *POPULAR SCIENCE MONTHLY*), it is constructed in twelve separate precast sections of reinforced concrete, built in a dry dock, floated ten miles down San Francisco Bay to the spot, and lowered to a trench in the bed of the estuary. There, forty-two feet below the surface, the mammoth cylinders were joined in a continuous, water-tight line.

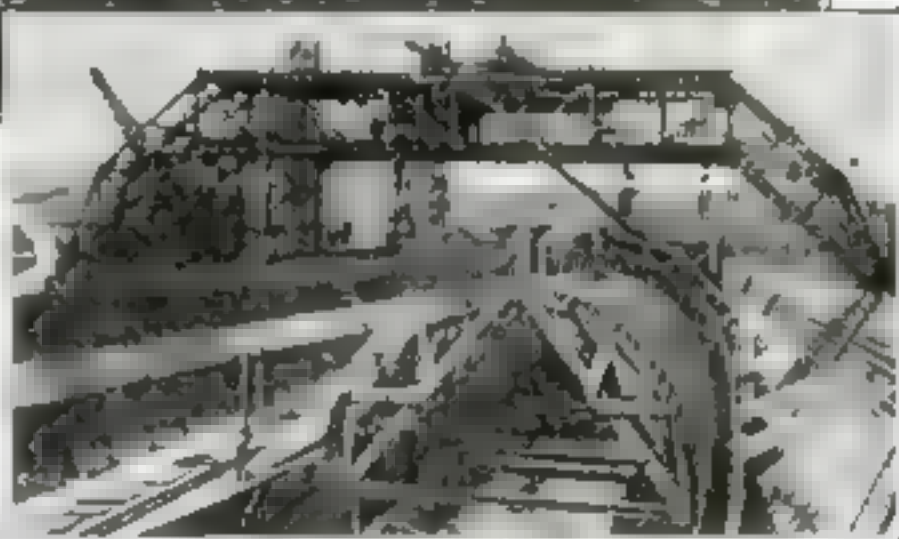
The completed tube measures 3545 feet between portals, 2400 feet being under water, and its outside diameter is



A 200-foot, 4500-ton section of the tunnel being towed to position. The tug at rear is guiding it

thirty-seven feet, seven and a half feet wider than the Holland tunnel. It will be capable of accommodating more than 12,000 motor cars daily, and also will contain double lines of street car tracks. In design and scheme of ventilation it resembles the Hudson tunnel. On each side of a twenty-three-foot roadway are sidewalks protected by guardrails. Powerful sixteen-foot fans in the portal buildings at each end of the tube constantly force in fresh air and draw out stale air.

The sections, weighing 4500 tons



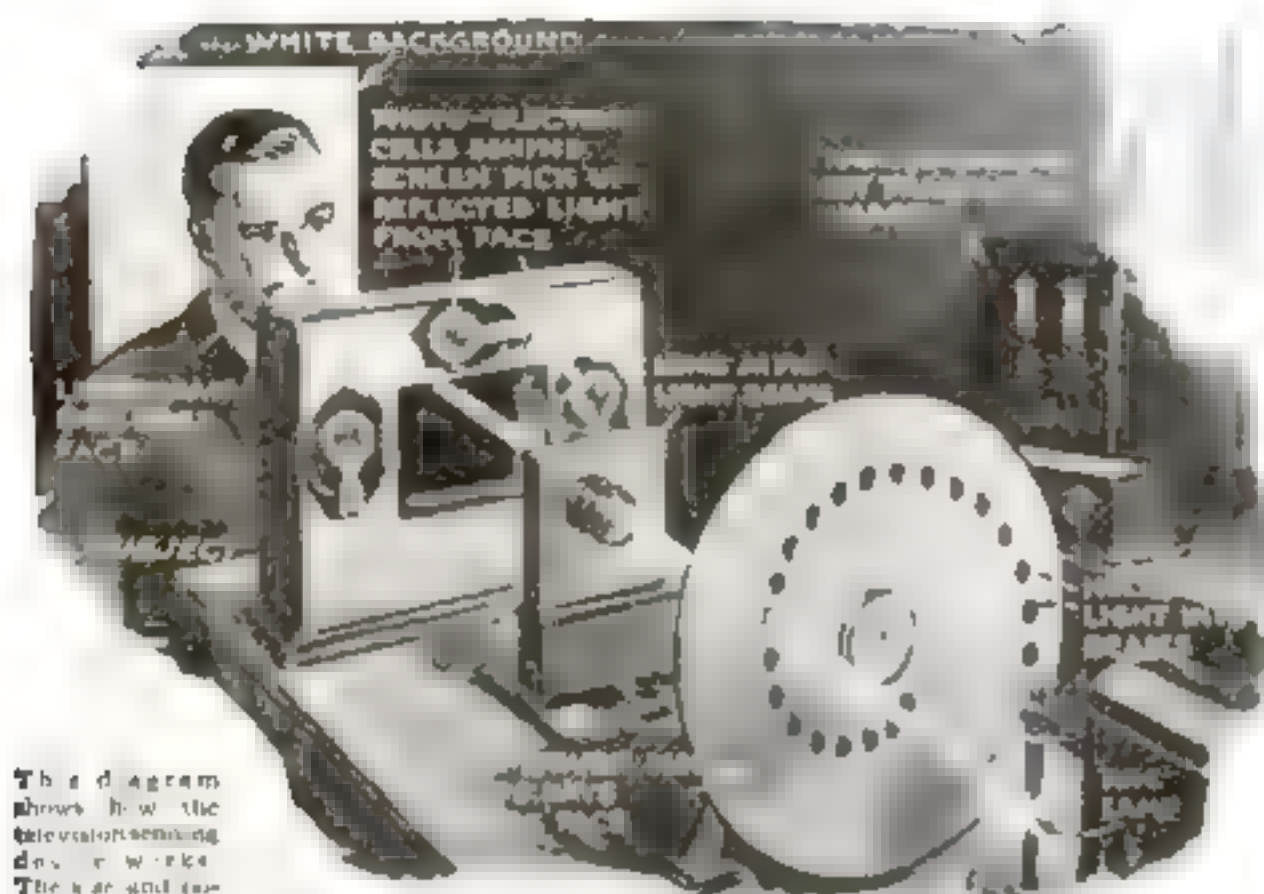
Above: Picture diagram of Oak and Alameda tunnel showing novel method with interior view and sectional view illustrating the method of ventilation. Below: Diagram of reinforced concrete section in bed of creek. The completed roadway slab is visible at the bottom.

apiece, were cast in enormous forms in a 750-foot dry dock at Hunter's Point, San Francisco. Into each went 250 tons of reinforcing steel, 2500 cubic yards of concrete and 25,000 square feet of three-ply membrane waterproofing.

AS EACH ponderous segment was completed, it was made water-tight by bulkheads and towed by tugs to a position above where it was to rest. Then, with 2000 tons of sand and water ballast inside, it was slowly lowered by winches, being kept in accurate position by guiding masts at each end.

The final and most difficult problem was that of joining the segments forty-two feet under water. It was solved by the ingenious scheme of casting square collars near the ends of each segment. Where the segments join, these collars are six feet apart. Sheets of steel are locked in place across the collars, forming a steel compartment around each joint. The compartment then is filled with concrete, sealing the joint perfectly.

Television Brought Into the



This diagram shows how the television sending device works. The light and camera of the photo are aimed for the sake of clearness.

THE BROADCASTING STATION

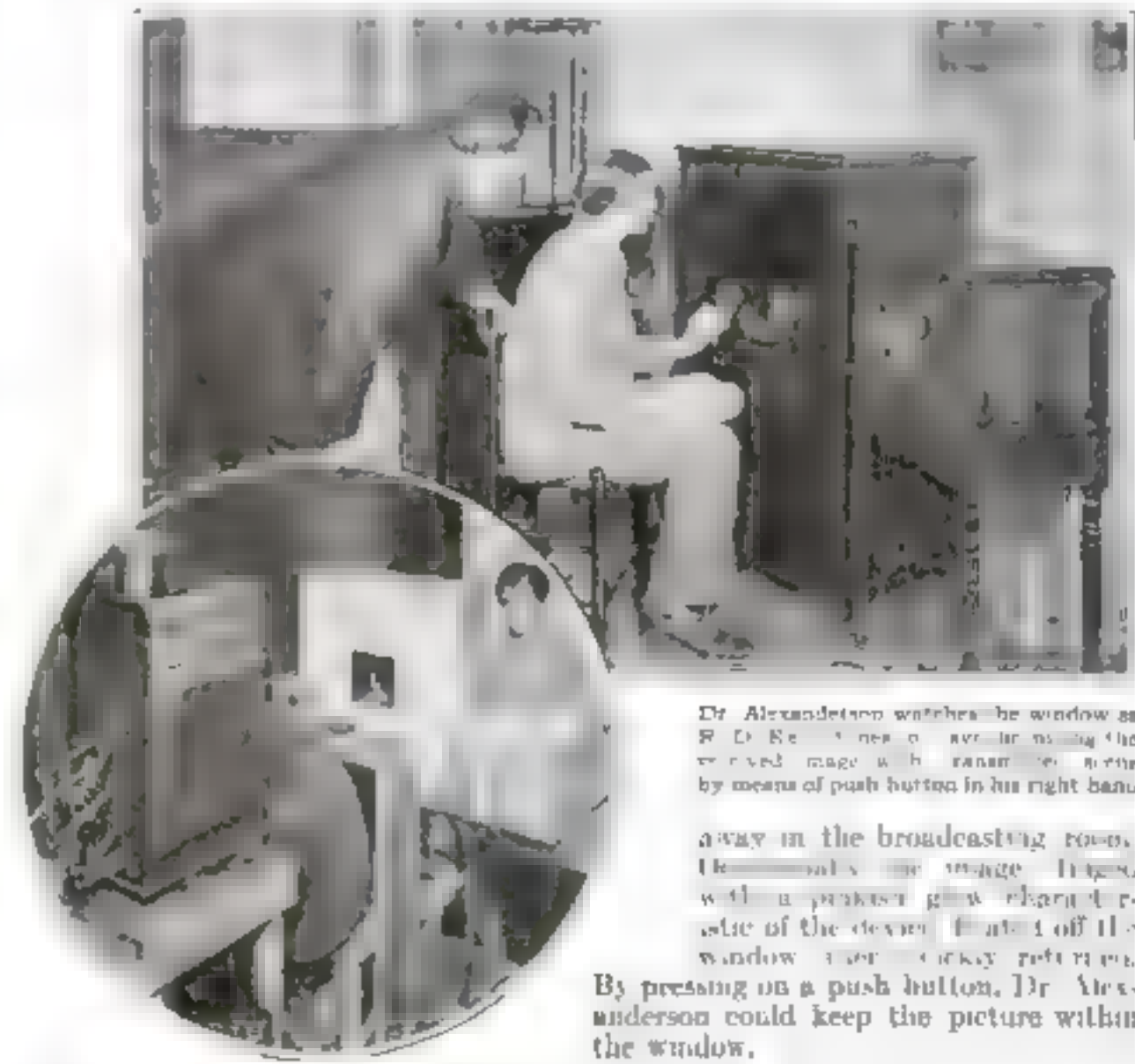
NOW you are to have a see-by-radio outfit of your own—a device that will enable you to view the prima donna and the musician in a distant broadcasting station just as plainly as your radio receiver permits you to hear them. Engineers are putting the finishing touches on a home television cabinet that they are preparing to make and market by the thousand!

Television, or "radio sight"—only a few months ago a laboratory marvel—has emerged a vital, real fact for the layman. The first few home television sets are already built. In their three-inch windows, the first four private owners, in four Schenectady, N. Y., homes, are looking at faces miles away by radio. Giant high-power radio television stations at Schenectady and San Francisco will soon replace the little experimental station of the General Electric Company at Schenectady that is now broadcasting the first regular television program in radio history. They will hurl faces and moving pictures clear across the continent!

A FEW weeks ago, radio experts gathered in the laboratory of Dr. E. F. W. Alexanderson, inventor of the new home television set, to see its first demonstration. They stood before a mahogany cabinet, its front ornamented with radio dials and an intriguing window three inches square into which they gazed expectantly.

"All ready?" came a voice from a loudspeaker near by. A whirring sound came from the cabinet. Light flickered across the window. In it appeared a face—the moving, living face of a man in the broadcasting room adjoining. "That's Wilkins!" someone exclaimed, even before

they heard the voice of Dr. Alexanderson's young assistant on the near-by loudspeaker. It was Wilkins—talking, grimacing, smoking a cigarette as plainly as if you were looking at him instead of seeing his image broadcast by radio!



Television transmitter showing arc light holder, perforated disk and lens casting rays on subject.

Only with elaborate and costly apparatus had such a feat ever been achieved before. Last year the Bell Telephone Laboratories heralded successful television with a mass of apparatus that successfully made visible to New York City spectators the face of Secretary Hoover in Washington, D. C. Dr. Alexanderson, meanwhile, was working on an elaborate projector to flash distant events as they occurred on huge theater screens. That idea has been shelved, for the moment.

"**O**UR first goal, and our hardest problem, has been to make a cheap television receiver," Dr. Alexanderson told me. And engineers who saw it estimated that his latest invention could be sold, in its present form, for four or five hundred dollars. You might make one yourself, they said, and still have change from a hundred-dollar bill!

Imagine yourself seated before such a cabinet. Your loudspeaker is already bringing music to your ears; now you want to see the singer. You twirl the television dials, fine black dots appear on the window. You tune more carefully, the dots become coarse ones . . . black streaks . . . wide splotches . . . and a face appears! It is the singer, clear and distinct. You settle back in your easy chair for the weird experience of seeing and hearing by radio.

In Dr. Alexanderson's private home at Schenectady I watched the miracle. I could see R. D. Kell, his chief assistant, playing the harmonica several miles

Dr. Alexanderson watches the window as R. D. Kell's face appears in moving the moved image with camera lens, by means of push button in his right hand.

away in the broadcasting room. He sends the image, through a pinkish glow characteristic of the device, straight off the window over a corky reflection.

By pressing on a push button, Dr. Alexanderson could keep the picture within the window.

Of course, the "picture radio" is not perfect. No one claims it is. It is a

Home—*The Newest Radio Marvel*

By
ALDEN P. ARMAGNAC

practical set for you and me, not a million-dollar laboratory curiosity. Black lines faintly streak the image, though faces are clearly recognizable. You cannot see colors by radio. "That will come later," Dr. Alexanderson said. Outdoor scenes of large area—football games and parades, for instance—cannot yet be transmitted, only persons in the broadcasting studio, sitting in artificial light, or moving picture films. But this is the first practical step—far more than halfway—toward seeing and hearing distant events perfectly without leaving your chair.

How is it all done?

ESSENTIALLY, the transmitter chops a man's face into pieces like those of a picture puzzle, and radios them to the receiver where they are put together again. Eighteen such picture puzzles a second follow one another in succession. Flashed on the receiving screen at a speed a little faster than motion pictures, they have the same effect of continuity.

At the broadcasting station, a beam of light skims over the face of the subject sitting in semidarkness. Another follows, bordering the path of the first just as you skirt with your lawn mower a path you have just traversed. Forty-six more in quick succession scan the man's features

completely; they are aimed by a whirling disk pierced with a spiral of holes, each thirty-five thousandths of an inch in diameter. "Some other systems use lenses, or mirrors," Dr. Alexanderson

said, "but a hole is cheaper than a lens, and forty-eight holes are cheaper than forty-eight lenses." Mirror disks, he said, may eventually transmit outdoor scenes.

Sensitive electric cells in front of the subject translate into electric impulses the lightness or darkness that the exploring beam reveals. "White," they radio when it strikes the man's cheek. "Black," they signal when it strikes his mustache. "Grey"—a weak impulse—as it passes over a shadow.

In your home cabinet a pinkish electric bulb, a "neon glow tube" that can light or extinguish itself in a millionth of a second, is glowing momentarily when the signal comes "white" and going out for "black." In front of it a whirling, pierced disk just like the one at the broadcasting station, and spinning at exactly the same speed, is aiming the light

flashes at the right places in the window. The picture puzzle is put together again, and what you see is the face of the subject, miles away!

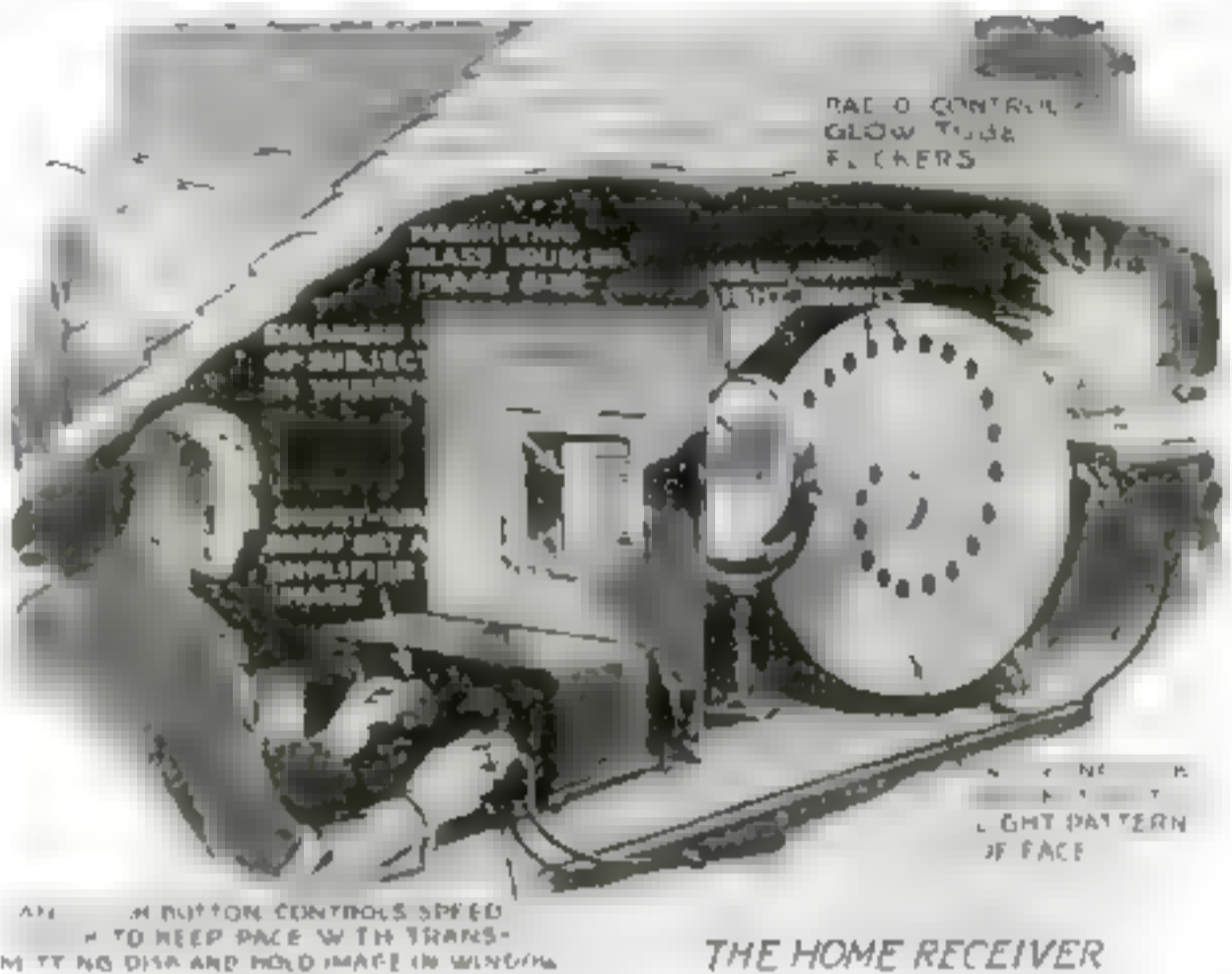
One startling improvement Dr. Alexander has made defies the long-accepted belief that some automatic, complicated synchronizing device must be provided to keep the transmitter and the receiver working at exactly the same speed—so that the picture will stay in the receiver's window instead of slipping across it. Instead, through a push button held in your hand, you can regulate the motor that drives the whirling disk in your receiver. When your disk is running at the same speed as the disk in the broadcasting studio, the picture is steady!

SO, WITH a motor that is the duplicate of the one in your vacuum cleaner or sewing machine; a metal disk that any machinist will make for, say, fifteen dollars, a "neon glow tube" that will be inexpensive soon, when it is made in quantity, and a short-wave radio receiver that is easily built—with these you can, some day before long, construct your own television receiving set. Or, if you prefer, you will be able to buy one—for television is going into quantity production!

This is the climax of years that Dr. Alexanderson has spent on the problems of radio vision. "We knew how to go about it," he told me, "but we had to be optimists and wait for new ideas, new devices that would make it practical. D. McFarlan Moore, of the Edison Lamp Works, made such a discovery in the neon tube we are using. To avoid eyestrain of the person being broadcast, we adapted to our use the ingenious system of photo-electric cells that the Bell Telephone

(Continued on page 145)

(Continued on page 149)



How television reviews work. Size and location of some parts exaggerated for sake of clarity.

RADIO STEREOPTICON, TOO



Another of Dr. Alexander's inventions recently demonstrated from the New York broadcasting station WJAF, is a transmitter and a home picture receiver, the latter attachable to the ordinary radio set. By means of this a radio owner may receive still photographs of performers, printed radio programs, musical scores and the like, which are broadcast from any station having the transmitting equipment. Similar to commercial outfits, but greatly simplified, it is devised to serve radio listeners as a stenoception serves the audience in a lecture hall.

It requires ninety seconds to transmit a single picture. The original picture is scanned by a light beam and the various lights and shades transmitted to the receiver, where they are impressed through a Moore glow tube on photographic paper. When this is rinsed in chemicals the picture appears.

Dr. Alexanderson, who with D. McFarlan Moore, inventor of the glow tube, perfected this device, is shown above working on an experimental model of the picture receiver.



Over every meal you eat may hover the shadow of an inefficient icebox, an insidious menace to health.

Dangers That Lurk In the Family Icebox

*Popular Science Investigation Reveals
Startling Facts about Household
Refrigeration and Your Health*

By **FREDERIC DAMRAU, M. D.**

FOOD in nine out of ten families in this country is kept in such a way as to be a menace to their health. That statement is not the cry of an alarmist. It is made only after the most exhaustive investigation into household refrigeration ever undertaken anywhere in the world; an investigation which reveals the startling fact that in most American homes food frequently becomes unwholesome and sometimes even poisonous, because of inadequate refrigeration.

Distinguished both as a physician and as a research worker, Dr. Damrau brings to this, the first article in an astounding series, a thorough study of the medical aspects of household refrigeration; a study that qualifies him pre-eminently for the inquiry. Every householder and parent should read this.

For almost a year the editors of *POPULAR SCIENCE MONTHLY*, engineers of the Popular Science Institute of Standards and I have been studying food in the

family icebox in its relation to health. We have had the help of several thousand investigators, including medical and public health authorities in almost every state in the Union. And as, one by one, the grave facts have been disclosed, it has become apparent that people should be told of the dangers, especially to children, that lurk in only too many iceboxes.

These investigations show that in the vast majority of homes there is either no icebox at all or one which is not efficient enough to check the growth of microbes

in milk and other foods. And they show, too, that most people are ignorantly satisfied with refrigerators in which butter doesn't melt and milk doesn't sour in twenty-four hours, utterly oblivious of the possibility of insidious treachery in the icebox.

Unfortunately, conditions today are just about what they were fifteen years ago when Dr. John R. Williams, of Rochester, N. Y., wrote in the *Journal of the American Medical Association* that "most of the refrigerators in common use are almost worthless and grossly uneconomical."

Now I do not want to convey the impression that no icebox is better than a poor icebox, or even that there is no such thing as an effective family icebox, a refrigerator that will maintain temperatures low enough to check disease. But I do urge that you owe it to your family to be sure that your box properly protects your food and your health.

GOOD boxes are made and sold. Tests at the Popular Science Institute of Standards show this conclusively. But the construction costs of such refrigerators are such that no really effective icebox can be sold profitably today except at a price which is greater than the average householder has been paying. More than sixty percent of the refrigerators in use in the United States were manufactured to meet price demands of \$18 to \$44; only six percent are sold at prices over \$100.

Cheap, poorly constructed boxes have little or no practical value as refrigerators. It is such boxes we are discussing. They are the kind that most American families are using.

People assume they keep food properly. Perhaps they will—in the winter time and if kept outside. But a poorly constructed box, even packed with ice, cannot maintain proper temperatures in its food and milk compartments in the summer time with temperatures ranging at an average of 80° in the shade.

And it is in summer months that a refrigerator must be depended upon to preserve food properly. And "properly" means maintenance of temperatures that will check bacterial growth.

FIGURES that will be given further on in this article will show how bacterial growth occurs even when the food is kept at a temperature as low as 50°.

A good refrig-

Choosing An Icebox

Next month, Doctor Damrau will tell just what happened to food placed in various types of refrigerators.

The tests mentioned here have disclosed to engineers of the POPULAR SCIENCE INSTITUTE OF STANDARDS a number of refrigerators which they approve as safe and highly efficient. A list of these will be sent to you on request. A booklet, "Refrigeration for the Home," advising how to select and care for a refrigerator, also will be sent on receipt of 25 cents. Address POPULAR SCIENCE INSTITUTE OF STANDARDS, 250 Fourth Avenue, New York City.

erator is more than a beautifully lacquered box, trimmed with metal, housing a series of conveniently arranged shelves. It must be built properly to keep out heat, and insulated with material able to resist the heat waves that are constantly trying to creep in.

Perhaps the simplest way to test the efficiency of a refrigerator is to place a thermometer in the bottom of the food chamber and keep it there thirty minutes. The temperature should be about 45°, certainly not more than 50° on the Fahrenheit scale, commonly used on household thermometers. Such a test should be made with the box in a room where the temperature is 70° or more, since it is in the summer, when temperatures are above 70° and frequently above

90°, that an efficient refrigerator is most necessary.

At 45° bacterial growth is markedly hindered, although it does not entirely cease. Germs multiply with great rapidity above 50° and food kept at higher temperatures soon begins to spoil. Yet few household refrigerators maintain any such temperatures for any length of time, the failure being due either to faulty construction or to insufficient ice.

Engineering tests of household refrigerators show that temperatures are often ten degrees or more higher. Such conditions make good incubators and favor bacterial growth. Temperatures above 50° make it possible for billions and billions of germs to grow in food, to feed on it and leave poisonous refuse, making it unfit for human consumption.

SOME idea of the rapidity with which bacteria multiply may be obtained from experiments made by Dr. William H. Park, Director of Laboratories of the New York City Department of Health, who tested a very fine sample of milk obtained under the best possible conditions and containing only 3,000 germs in fifteen drops—less than one tenth the number of bacteria ordinarily found in the Grade A milk used in the tests illustrated on page 24. Kept twenty-four

hours in a temperature of 50°, the bacterial count became 11,000; and when raised to 55°, 18,000; to 60°, 180,000; to 65°, 430,000; and to 80°, 1,400,000,000.

These figures mean something when we remember that the number of bacteria in milk is the best single index of its general sanitary condition.

AND it is just as true that not all bacteria are dangerous. Many are quite harmless. But if the germs present in food in a poor icebox should happen to be typhoid bacilli or the microbes of common meat poisoning, serious and immediate illness—perhaps death—may result. And microbes responsible for food rot, and certainly the chemical products formed by their action in decaying food, are also positively injurious to health. The difference between them and those causing more sinister diseases is that their harmful

action is slow, subtle and insidious. In either case the development of these germs could be retarded by an icebox that really refrigerates.



Expert investigators with thermometers tested iceboxes throughout the country and owners were amazed to see how almost worthless many were.

Typhoid bacilli, the cause of typhoid fever, multiply at temperatures above 50°. Below 50°, growth is checked. Of course, no food should contain typhoid bacilli when purchased, but it sometimes does. And a refrigerator that fails to maintain a temperature below 50° will allow these germs, should they be present, to multiply to dangerous proportions.

It is true that a temperature far below 50° will not destroy typhoid bacilli. But with germs, as with drugs, the matter of dosage is very important. The body may resist the onslaught of a relatively small number of microbes but succumb if they are increased a thousandfold. The degree of danger from typhoid in milk is increased in direct proportion to the multiplication of the disease germs.

And the icebox food compartments in perhaps eighty percent of American homes fail even to approximate a temperature as low as 50°. Sometimes food may taste good and still be poisonous. The United States Department of Agriculture recently pointed out, for example, that while food generally shows when it is spoiled by unpleasant look, taste or smell, it may be contaminated by organisms that make it unsafe even though it appears good.

BUT comparatively few public health officials have given more than scant attention to household refrigeration. A notable exception is found in Louisiana, where a most efficient official's investigation of 18,000 family refrigerators proved convincingly the uselessness and danger of the average icebox.

Cold storage has been thoroughly investigated and the Government rigidly enforces safe low temperatures for food in storage and in transportation. But the care it receives after reaching the family icebox has been left almost entirely to chance.

Milk offers one of the best and best known illustrations of the fact that good milk may appear wholesome to both taste and smell long after it has become actually unfit for use. Bacteriological tests have repeatedly shown that milk which even the most delicate taste could not criticize can be so filled with bacteria that the use of it in any quantity would be almost certain to result in serious illness. Every hospital requires the most careful and exacting tests for milk served to patients, since taste and smell cannot be relied upon.

Some months ago *POPULAR SCIENCE MONTHLY* asked several thousand of its readers to tell what make of icebox each used and the price paid for it. For the purposes of this investigation it was assumed that the boxes used by the largest number of readers were in widest general use throughout the United States. Then samples of each of three widely sold nonmechanical refrigerators were purchased.

THE boxes were bought in the best known department stores in the United States, two in Chicago and one in New York. For the refrigerators ob-

tained in Chicago, \$61 and \$34 respectively were paid, for that in New York, \$39.50 was paid. Each box was the product of a different manufacturer and in each case the department store salesman offered assurances that the box sold would keep food at proper temperatures to safeguard health.

THESE boxes, all new and in excellent condition, were taken to the laboratories of the Popular Science Institute of Standards at New York University. There, in an especially built and equipped room in which a constant temperature can be maintained, they were put through an elaborate and exhaustive series of tests of their efficiency.

HOW BACTERIA MULTIPLY IN HIGH GRADE MILK KEPT IN A POOR REFRIGERATOR



SAFE REFRIGERATION TEMPERATURE

BACTERIA AT TIME OF PURCHASE 30,000 PER CUBIC CENTIMETER (15 DROPS)



BACTERIA PER CUBIC CENTIMETER WHEN KEPT AT 68 DEGREES— AFTER ONE DAY — 4,000,000 TWO DAYS — 25,000,000,000

What tests by Dr. William H. Park, New York City Health Department expert, show about refrigeration

One refrigerator placed in the test room when the temperature was 74° maintained an average temperature of 61° in the food chambers. Another maintained an average temperature of 57° with a room temperature of 74°

Every possible advantage was given the boxes in the tests. The average family box is usually only partially filled with ice, but these were filled to the limit. Family boxes have their temperatures increased by having their doors opened several times daily, but the doors of the boxes under test were kept closed. Warm foods usually increase the temperatures in household refrigerators; but

no warm food was put in these boxes.

Another test made on the other refrigerator duplicated as closely as possible the conditions that exist when a box is in normal use in a household. Heat was produced inside the box equal to the normal heat from food and from opening the doors several times a day.

The room temperature was maintained at 78°. In this box the average temperature was 62.7°. For food preservation these temperatures proved the refrigerators little better than ordinary wooden boxes in cool pantries.

In fact, they were worse, because they offered a false sense of security, a point made clear when I recall seeing a number of cases of severe sore throat in children in my neighborhood several years ago. The condition proved to be septic tonsillitis, due to the presence in milk of the microbes which cause "blood poisoning."

The little daughter of a neighbor became extremely ill with a high fever and a very bad throat.

"Never again buy poor milk," I admonished the father.

"I always get Grade A," he answered.

"Don't keep the milk on the window sill. Put it in the icebox," I insisted.

"Yes, and in the milk compartment, too," he added. "I have always done that."

Then he took me into the kitchen and opened the door of his icebox. The ice chamber was filled. And the milk was in the proper place, in the small compartment just below the ice chamber.

I PLACED a thermometer alongside the bottle of milk. The temperature in what was supposed to be the coolest part of the refrigerator for food was 68°. Given the presence of infectious germs, it was small wonder that the microbes thrived.

The investigations of *POPULAR SCIENCE MONTHLY* overlooked no important phase of household refrigeration. In the actual tests on refrigerators, the most exact and scientific methods were employed. Several thousand readers of the magazine cooperated in supplying information about their experiences with iceboxes. Able investigators in fifty typical cities interviewed housekeepers to obtain information about actual conditions of refrigeration as they exist in the average home.

These men, equipped with standard thermometers, tested temperatures in the various compartments of hundreds of refrigerators in actual use.

EACH investigation, conducted independently of the others, revealed the amazing fact that the vast majority of iceboxes in use in American homes are incapable of maintaining temperatures that will preserve food properly. And more alarming to me as a physician is the fact that most people seem totally ignorant of the menace to their health of such refrigerators.

Indeed, comparatively few learn of it except by bitter experience.

Sea Whippets Thrill in Newest Sport



Entries "lining up" for most thrilling of speed boat races in choppy sea off San Catalina Island. In foreground Kneeland gets in the winner at the finish—drenched to the skin and his raft waterlogged.

Speedy Little "Kickers" Leap Madly Over Waves in Spectacular Contest

By ELLSWORTH BENNETT

LEAPING and plunging recklessly through white-capped waves, kicking the choppy sea into spray, more than a score of the world's smallest speed boats recently engaged in one of the most spectacular contests ever seen in American waters. It was the race of tiny outboard motor boats, familiarly called "kickers," run over a fifty-two-mile course on the lee side of Santa Catalina Island, off the coast of southern California.

So light and cranky were the little craft, and so rough the going, that of all the entrants in the sweepstakes only one was able to finish. It was the *Sea Sled*, piloted as pictured above by Kneeland

Jenkins, of San Diego, which "put-putted" over the course in three hours and fifteen minutes, an average of sixteen miles an hour.

Matching these whippets of the sea is one of the newest and most thrilling of sports, as the contest proved. The course had been laid once around the island, including a leg on the ocean side, but a stiff northwester made the ocean trip impossible and the course was changed to two round trips along the land side of the island, starting at Avalon at the south.

As it was, the pilots, three of them women, had to call upon all their skill and seamanship to keep their craft right

side up. At the halfway mark Ross McPhee, of Los Angeles, president of the Southern California Outboard Motor Boat Association, was leading when a heavy wave swamped and sank his *Gaucha*. He barely escaped injury.

Most of the boats are designed along special speed lines, some of them of the "sea sled" type, and all of extremely light construction. They weigh from sixty to ninety pounds. Under favorable conditions the best of them can be counted on to do from twenty-seven to thirty miles an hour, while the highest recorded speed is thirty-one miles an hour. Numerous models were exhibited at the recent motor boat show in New York City.



A speed boat doing all its leg on land—no escape without of the water.

"Can I Afford an Airplane?"

Amateur Pilots Throughout the Land Explain Here the Dollars and Cents of Private Flying

By H. C. DAVIS

FLYING for pleasure! Who has not dreamed of owning and running his own airplane? Each morning the papers tell you of airmen's latest exploits. "I could do that, too," you confide to yourself.

After all, why not? Over your head passes the air mail. You thrill with the longing to be up there, to listen to the song of an unbridled, throbbing motor and the tune that the wind plays on singing struts. Of course you would astonish your fellow townsmen. You would loop the loop over Main Street and sail aloft above Broadway while they marveled at your daring. With spring in the air, you think of distant haunts you would visit when summer comes—miles by road, but only a few hours' dash by airplane.

From such pleasant daydreams you awake rudely. "How could I own a plane? Wouldn't it be far too expensive? Too risky? How could I afford to run it? Where could I keep it?" These and a host of other practical questions assail you with doubts.

To answer them, *POPULAR SCIENCE MONTHLY* has just completed a nation-wide survey, the first of its kind, to find the real facts about the dollars and cents of private flying. These facts fill an imposing sheaf of letters we have received—letters from dozens of men, among them lawyers, doctors, bank officials and students, whose hobby is flying. And with surprisingly few exceptions, these men who take to the air for pleasure rides, hunting, vacationing, and business trips combined with pleasure, advise you and the next man by all means to own and operate a plane.

What sort of plane? That depends upon your purse.

"My plane, a little Waco nine that I take on hunting trips and use to show my friends the beautiful inaccessible country on the other side of the mountains, cost \$2,500," says Thomas D. Stinson, of Seattle, Wash.

"**MY SHIP**, a three-place Stearman biplane that I use for traveling on personal or company business, cost \$3,550," writes W. Lester Lamkin, of Porterville, Calif.

These were new planes. But you might be able to find a bargain, second hand. Or, if you are confident enough of your skill, you might build one.



J. D. Alexander, Denver, Colo., says he has had no serious mishaps since flying his light biplane, in which he is seen at right.



A feature of "Airplane Row," a long street devoted to airports in Los Angeles, California, is this office where airplanes are "bought, sold and financed," just like automobiles.

"I built one of my two small planes," says Paul Crippen, an engineering student at Northwestern University. "Even after I had replaced the rebuilt motorcycle engine I used at first with a fifty-horsepower Gnome motor, the whole cost of construction did not exceed \$800. My second machine, just like it, I bought second hand for \$750. I keep them both in our barn, with their wing spread of only twenty feet, so it is easy to get both planes through the normal-sized garage door by manipulating one wing at a time."

E. Park and his brother, of Beloit, Kansas, built their own plane for \$1,000. "We bought an unserviceable tail group for \$100; and gave \$1.50 for a pair of new, partly completed U. S. A. 27 wings."

After buying a second hand Curtiss motor and other parts required, they fitted them together and found they had a plane that flew perfectly. It would take off easily with three persons on board.

At the other extreme of amateur aviation is the business man, the flying enthusiast, whose luxuriously equipped plane costs more to run and is more expensive to repair.

H. S. H. Baker, purchasing agent of

a great Buffalo, N. Y., public utility concern, prefers traveling by plane to a trip by automobile or train. "My five-passenger Stearman biplane, equipped to plane," he tells us, "sells for \$14,000 to the factory."

W. J. JOHNSON, a Chicago bank officer and a flyer by hobby for years, owns a \$12,000 biplane powered by a Wright Whirlwind motor. "The only use to which I put my ship is pleasure," he says. "I spend it taking my wife and seven-year-old son for a short week-end trip in the family car, as I used to do, we now climb aboard the ship and take a regular trip. On my two-week vacation we went to California, an excursion that limited time had previously rendered out of the question."

There are the figures. Pick your own plane. One outstanding fact emerges: that the actual cost of a plane suitable for an amateur aviator is far less than is popularly supposed. Prices of famous planes may have given you a wholly exaggerated impression of what more modest flying machines may cost. *POPULAR SCIENCE MONTHLY* found among private pilots a distinct preference for small, light planes of the \$2,000-\$3,000 class. Some more costly machines brought the average up to \$3,000. In first cost, at least, airplanes compare favorably with automobiles, particularly when their greater speed and



D. E. McDaniels (left), automobile dealer of Pasadena, Calif., receiving "the first pilot's license on the Pacific Coast" from Capt. Walter Parkin, U. S. Department of Commerce Inspector. McDaniels is 46 years old, and made his first solo flight when 45. He flies to his place of business.



"Daddy" Munce of Santa Monica, Calif., a lieutenant pilot at 45, and his three sons, all pilots. "Daddy" is second from the left.



Dr. R. R. Frey, son of Chicago, with plane he flew to meetings of the American Medical Association and returned it without any mishap.

freedom from traffic restraint are considered.

But the running of them—is that the catch? Does it cost more to operate a plane than a car, or less? Is a plane an expensive luxury, or a practical vehicle for the average man? Here are some figures given by typical owners.

"Including insurance, gas, oil maintenance, storage, and depreciation, I can run my Waco biplane with ninety-horsepower motor for six to seven cents a flying mile," asserts J. Van Wagner of New York City. His is nearly the average expense, seven and a half cents a mile, for this class of owner—the man who stores his plane in a public hangar, inspects the plane and perhaps makes minor repairs himself, and has his work checked now and then by an expert mechanic at the field. That means that it would cost, say, \$750 to cover 10,000 miles in a year. Hangar rent is a big item in the budget, and constant mechanical service would be another heavy expense.

For pilots who house their planes in their own hangars,

five cents a mile is the average cost.

"I care for my own plane, keep it in the municipal hangar, and am charged no hangar rent," says Albert L. Burnham, of Hartford, Conn. "It costs me about four cents a mile to fly."

"I store my secondhand Curtiss JN4D at the Buffalo airport during the summer months and at home in the barn during the winter," writes Earl P. Merlan of Strykersville, N. Y. "My friends and I do most of the repairing and then have one of the mechanics at the airport look

it over. I estimate it costs me six cents per mile to fly, including gas, oil and repairs."

Most pilots of this class are able to include depreciation and other expenses between these two figures.

BIG planes? That means expense. Says the owner of the five-passenger enclosed biplane, "It costs me seventeen cents a mile to operate my machine. A smaller three-passenger Travel Air open biplane costs ten cents a mile to run, including all items." These included such mechanical attention as periodical overhauling of the motor by trained mechanics. The man who demands expert service as well as hangar space for his plane will pay from ten to twenty cents for every mile he flies. But "any person using caution can service and inspect his plane with a small amount of experience," says O. C. Capper, of Dewart, Iowa. "There is a pleasure in caring for your own plane."

All in all, the average cost for every class of owner is nine cents a mile. Some of the figures given compare favorably with the cost of running a car. Three pilots declare that their planes cost as little or less to run than their averaged-priced automobiles, pointing out that

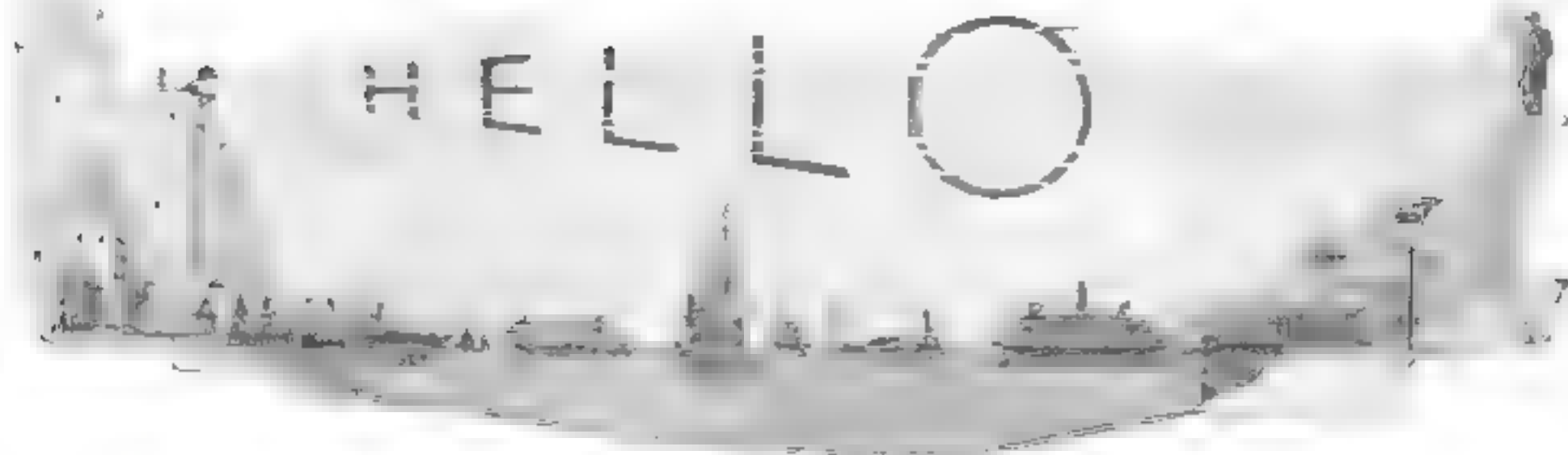
(Continued on page 104)

What the Figures Show

Here are the facts about the cost of private flying compiled from the reports of representative amateur pilots to POPULAR SCIENCE MONTHLY in response to our survey.

	Low	High	Average
Cost of Plane	\$500.	\$12,000.	\$3,000.
Monthly Hangar Rental	15.	50.	25.
Flying Cost per Mile (Upkeep included)	.03	.25	.09

Fifty-four percent of the fliers use their planes for pleasure; thirty-six percent for pleasure and business, and ten percent for business only.



A Loudspeaker for a Million Ears

Mighty "Hello" Heard a Mile in First Test of New Device for Use of Public Speakers

By R. C. UPJOHN



Speaking by telephone from Hoboken, N. J., into loudspeaker across the Hudson in New York City. In five seconds the voice comes back over the river.

"HELLO, ferryboat!" boomed a tremendous voice across the Hudson River the other day, from a horn atop a New York building. Ferry passengers jumped in startled surprise at the Gargantuan shout, then waved at the New York skyline whence the sound had come.

But they had guessed wrong as to its original source. On the opposite side of the river, on a Hoboken, N. J., bluff, stood Dr. R. W. King, technical expert of the Bell Telephone Laboratories, speaking into an ordinary telephone transmitter in the first demonstration of an improved giant loudspeaker that could be plainly heard a mile away! His voice was flashed almost instantaneously under the river to the New York building of the Bell Laboratories, where it actuated the great horn on the roof.

The amazing horn, as E. C. Wentz and A. L. Thurns, Bell engineers,

have developed it, combines in one instrument all the latest loudspeaker improvements. With its aid an orator might address a million persons at once! It is designed primarily for public addresses and, with modified power, for talking movies.

In a spectacular demonstration of tone quality, Dr. King had Mrs. King, at her Short Hills, N. J., home—twenty miles away—connected by phone with the horn and put "on the air."

"Believe me, if all those endearing young charms," she sang, and her tones floated clearly across the river.

The new horn is studded at the base with multiple transmitter units sounding as one, and is said to convert half the electrical energy it receives into sound. This is made possible by an extremely light aluminum diaphragm, thin as a human hair, in each unit, which responds vigorously to the slightest whisper electrically impressed upon it. It is mounted free to slide back and forth like a piston, together with the cur-

rent-carrying, telephone-connected "voice coil" of thin aluminum ribbon that drives it.

As it slides, the "voice coil" moves in a narrow slot between the poles and in the magnetic field of a powerful electromagnet. The attraction and repulsion set up between magnet and coil by the fluctuating voice current makes the voice coil and its diaphragm oscillate to reproduce the voice on a giant scale.

Great efficiency under large loads is obtained by keeping both the coil and

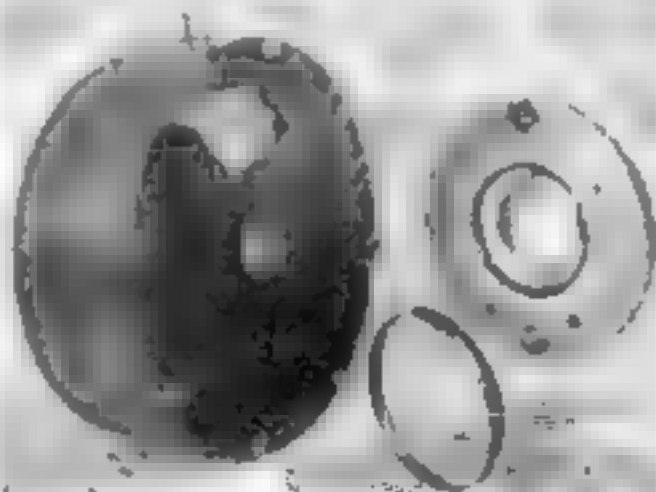


Dr. R. W. King with new loudspeaker, its base studded with speaking units sounding as one. The horn could reach a million people.

the magnet very narrowly separated.

Last of the new developments that produce the mighty voice is the horn itself. A concave shaping of the air chamber between the base and the mouth increases its extraordinary power.

In another test, inside the Bell building, engineers heard a special test of tone quality in which the horn gave musical pitches from the highest to the lowest.



Speaking unit mechanism, showing how voice current makes coil and diaphragm oscillate, magnifying sound.

Plants That See, Feel and Think

Scientists Stand Amazed as Hindu Botanist Records Emotions of Growing Things by Means of His Strange Electrical Machines

By ARTHUR A. STUART

IS THE potato a little step-brother to man? Is the cabbage our second cousin? Should we recognize vegetables as our poor but honest relations?

"Yes," calmly asserts Sir Jagadis C. Bose, a Hindu scientist of international repute, who for a quarter of a century has been doing sensational and thrilling things with plants.

"No," in a tone indignant and almost outraged, is the reply of conservative plant students.

The vegetables have nothing to say on the subject out loud, but their behavior in innumerable startling experiments tends to support the contention of Sir Jagadis. Through dots, dashes, curves and dancing spots of light made with electric pens they whisper, "We are alive! We are alive!"

Once there was a deep gulf fixed between the animal and vegetable kingdoms. Only poets ascribed life to trees and emotions to flowers. But no one took the poets seriously, perhaps least of all themselves. Then came Bose to declare that the poets are more than half right, that all life is essentially the same whether motile or rooted in the earth.

Here is a botanist, respected by scientists throughout the world, who says and has proved that plants have all the senses of the human being except perhaps bearing, that they have nervous systems and emotions, that they get tired, feel pain, become excited, drunk and depressed, and finally, that they have hearts, muscles and other anatomical resemblances to the human body.

SIR JAGADIS is a Fellow of the Royal Society and has, besides knighthood, other honors of the British Empire. He has written a dozen learned books detailing his original research experiments which can be duplicated and verified or disproved. The burden of disproof seems to be upon his opponents, who are an orthodox minority.

This man has put India on the scientific map. In his country he ranks with Gandhi, the statesman, and Tagore, the poet. He is hailed by some as the Darwin of



Sir Jagadis Chunder Bose, Hindu botanist whose discoveries that plants have the equivalents of heart and muscles and experience emotions like men have won him honors in the scientific world.

plants. But how does he compare with our own Burbank? The disciples reply that the American was indeed a wizard in the practical creation of new and useful plants. Bose, on the other hand, is a pure scientist. He has created nothing. He has only revealed to us a basic knowledge of how plants live and move and have their being. On this foundation a host of practical men will build and work out improvements in agriculture and many other branches of applied science.

The press has sadly exploited Bose, reinforcing his true miracles with travelers' tales of man-eating plants and whatnot. Bose has indeed in his Calcutta menagerie such freaks in the vegetable world as the Venus's-flytrap; with them he seems a botanical circus master and seems to make us gape at the exceptional. But his science, when we study it closely, ap-

plies to plant life as a whole, the ordinary trees in our back yard, the vegetables in our garden and the shrubs on our front lawn.

Jagadis Chunder Bose was born seventy years ago in southern India. His parents were Bengalese, his father a local magistrate, keen for his son's education and never too busy to answer the boy's endless "whys?" The home neighborhood had plenty of stimulation, what with river pirates and real tigers in the jungle.

At home his life work was perhaps foreshadowed when he built a miniature garden, including an ingenious system of irrigation with pipes and a little bridge over a stream.

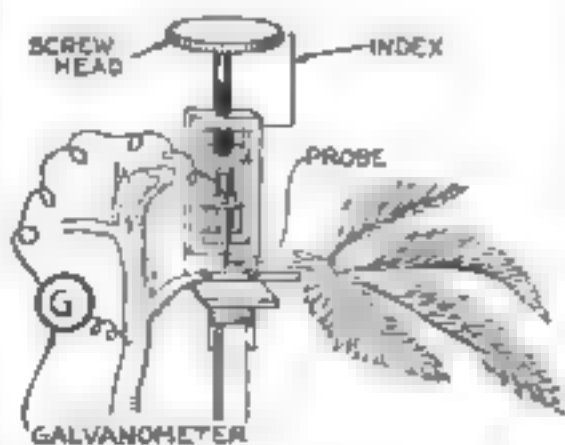
Completing his early education in Indian schools, the youngster went to London and enrolled as a medical student, later entering Cambridge University to take up science. He was graduated with honors and presently

found himself professor of physics at the British Government's Presidency college in Calcutta.

At thirty-five Bose first began to pioneer in science. With makeshift apparatus he studied the rays we now call radio. The Royal Society published his work, the University of London gave him a degree and Lord Kelvin wrote to him in 1896 that he was "literally filled with wonder and admiration over his success."

WHILE Bose did valuable pioneering in radio, it was for him no more than a needed foundation for his great future discoveries in plant life. He did not know it himself, but only a supreme electrician, such as he was becoming, would be able to capture the heartbeats and register the infinitely delicate nervous reactions of our vegetable kindred.

Friends advised Bose to take out patents. In 1901 a wireless manufacturer offered to buy his new type of receiver. He declined with thanks. Then a friend patented the invention in his name in America. Bose ignored the chance to profit and let the patent lapse. The Hindu scientist had the queer and, to practical westerners, insane idea that he could not take money for his contributions to knowledge.



When touched by the probe, plant nerve pulsations are recorded by galvanometer. The index shows the depth of the probe.

Soon he began to apply electrical tests to metals. He found that metals showed fatigue, were affected by poisons and had other lifelike reactions. If this were true of metals, how about plants?

"Full of this idea," says his biographer, Patrick Geddes, "Bose rushed out into the garden plot of his London lodging and gathered the first leaves of its horse-chestnut tree just opening, and on testing one of them, he found it respond vigorously. He next hastened off to the greengrocer, and found his carrots and turnips . . . turning out to be highly sensitive, even in their very roots."

Bose told the world about it on June 8, 1901, in a paper he read before the Royal Society. The eminent scientists present, who had approved his earlier work in physics, did not now applaud. Sir John Huxley Sanderson, the foremost physiologist of his day—but whose present title to fame is his denial of Bose's discovery—administered a polite rebuke to the Hindu for trespassing from his own plot of physics upon the ground sacred to physiology. Can plants tell their life secrets by electric response? No, no, quoth Sir John, he had tried it and failed, it could not happen. In short, the Royal Society buried in a pigeonhole instead of publishing one of the greatest pieces of scientific news ever presented to it.

THIS was "the severest shock of Bose's life"—more cruel than any he ever inflicted on a plant. He was as sensitive as mimosa that folds its leaves at a touch. But, "It is not for me to sit with folded hands in resignation," he wrote at this period. "I do not believe in miracles; but the miracle shall happen this time, for I know that I am fighting for the establishment of truth."

In fact the attitude of the Royal Society was a blessing in disguise. The physiologists challenged Bose to prove his thesis by making the plants themselves speak or write their own story.

"I'll make them write their story!" he cried.

And for a quarter century he has been publishing a sensational and thrilling series that might be called "True Confessions of Ye Plants, Signed and Sealed by Ourselves."

BOSE had to invent the "electric pens" needed by the plants to write with, and the creation of these marvelous devices would be sufficient honor for another scientist. Their delicacy is almost inconceivable. Some of them magnify growth and other motion from ten to one hundred million times! Is it true? You can see with the naked eye a growth at the rate of 1/100,000 inch a second translated or magnified to a motion of about one foot a second. As the spot of light travels thus briskly across the scale, we can almost hear the plant remark, "See how fast I grow!"

The happy ending of Bose's personal ordeal was assured when he gave a private demonstration to a group of English

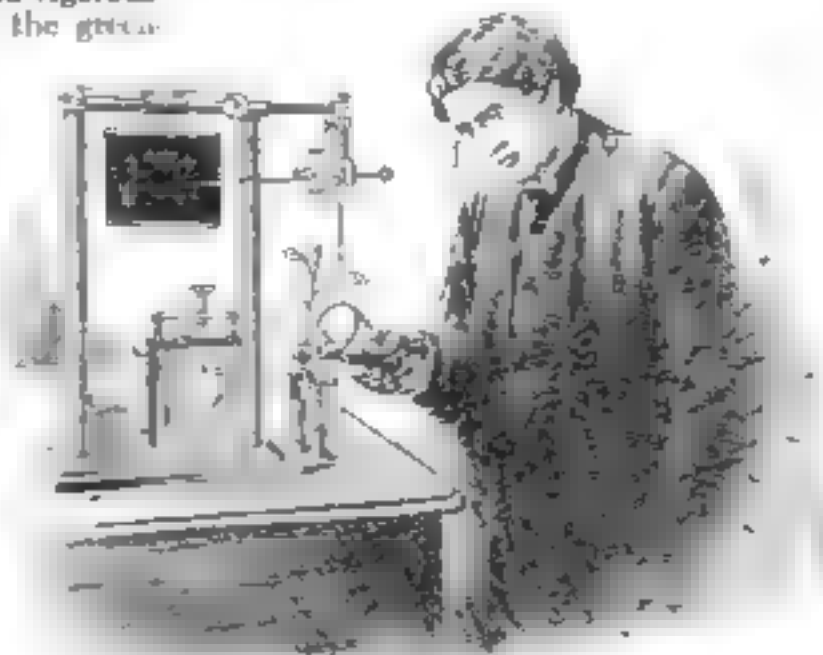
scientists and Howes, successor to the famous Huxley, exclaimed:

"Huxley would have given years of his life to see that experiment!"

The rejected Hindu became Sir Jagadis, feted by the Royal Society and acclaimed by the leading scientists of Europe.

Some of the more striking discoveries of Bose are these:

Plants have a nervous system by which



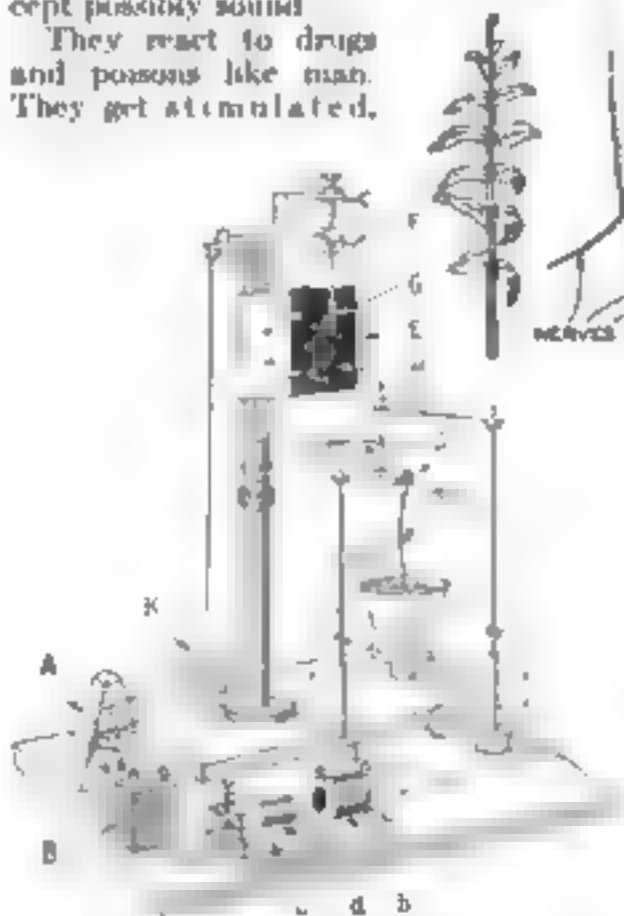
Sir Jagadis proving a plant's reaction when a chemical is poured into the test tube holding it. Thread tied to leaf moves a lever terminating in a pointer that marks record on smoked glass plate.

they receive messages and then act upon them—a two-way telegraph line precisely locatable.

They have something like muscles to act with, having lively movements of all sorts, internal and external.

They are sensitive to a touch, a passing cloud, bad air and about everything except possibly sound.

They react to drugs and poisons like man. They get stimulated.



Sir Jagadis' apparatus to make mimosa plant record its own reactions to electric shock. Shocks, delivered at D through wires from induction coil C, are regulated in degree by distance between coils a and b and in speed by metronome. A, connected with induction coil through battery, B. Through thread, E, kept taut by lever F, leaf transmits reactions to pen, G. Pen writes on smoked glass screen, H, which is moved by mechanism, K. Above to the right. The stalk of a fern and to the right of it a cross section showing positions of the nerves—much like animal nerves—as found by Sir Jagadis in his long study of plants.

excited, fatigued, drunk and depressed.

They die with a spasm, emitting high electric voltage at the moment of death.

They have the equivalent of a heart in pulsating cells which pump sap upward through their tissues. How else can a tall tree lift water hundreds of feet from the ground?

In fact, Sir Jagadis says in his latest book, "Plant Autographs and Their Revelations," which summarizes his life work, "there is no life-reaction in even the highest animal which has not been foreshadowed in the life of the plant. He goes on to say there is no division between plant and animal. The difference is in degree, not in kind. Plant and animal are 'a multiform unity in a single ocean of being.'"

ONE of Bose's devices he calls the resonant recorder. It writes automatically the quivers and shivers of a plant subjected at regular intervals by clockwork to small electrical shocks. A fine thread is tied to a plant leaf and then to a jewel-bearing lever that terminates in a pointer which taps on a smoked glass plate a series of dots one hundredth of a second or less apart. The dots make zig-zag lines showing how the plant jumps or shrinks at each shock, recovers itself, gets indifferent and finally fatigued. When too tired it stops answering, but after half an hour's rest it is "fresh as a daisy." One specimen suddenly became languid. Why? "A wisp of cloud passing across the sun" had been perceived in its effects by the plant before the experimenter noticed it.

While plants are practically deaf, their vision surpasses ours at both ends of the spectrum. The tongue of an average person perceives an electric current of six millionths of an ampere, but a plant is eight times more sensitive to electricity.

After getting the response of plants in mechanical movement, Sir Jagadis devised an apparatus to read their thoughts, as it were, taking down the answer through a galvanometer. They are full of thoughts, or at least inner activities.

They sleep, they wake perhaps they dream. We find that the carrot is an excitable creature, though vigorous.

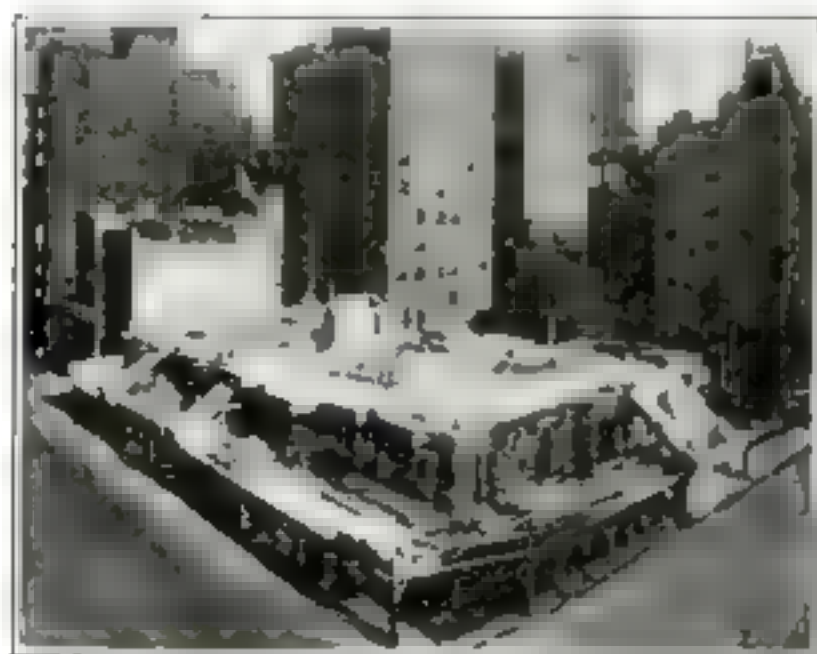
Celery is a delicate character, quite easily fatigued. Some day we may have a vegetable "who's who" and the slang expression "knowing your onions" will no longer be a figure of speech.

PERHAPS the greatest paradox which Bose offers to the layman is his tale of the death of a pea. All vegetables die hard, but it seems the kind we should not eat with a knife makes its exit with a tremendous electrical spasm.

"Take one half of a green pea," says Bose, "and connect its inner and outer surfaces with a galvanometer. The half pea is slowly raised in temperature in a heating bath. At the death-point of 140 deg. F., an intense electric discharge passes through the organism . . . being often as high as one half volt. If 500 pairs of half peas are suitably arranged in series, the terminal electric pressure will be 500 volts, more than sufficient to cause electrocution of unsuspecting human victims. It is well that the cook does not know the danger she runs in preparing this particular dish. (Continued on page 157)"

Skyscrapers Built While Tenants Wait

Astounding Engineering Feats Put Giant Buildings Around and Atop One Another and on Pine Log Legs



The twenty-nine-story Murray Hill Building, Madison Avenue and Fortieth Street, at its completion 648 working hours—a few months in elapsed time—after it was started.

By PETER VISCHER

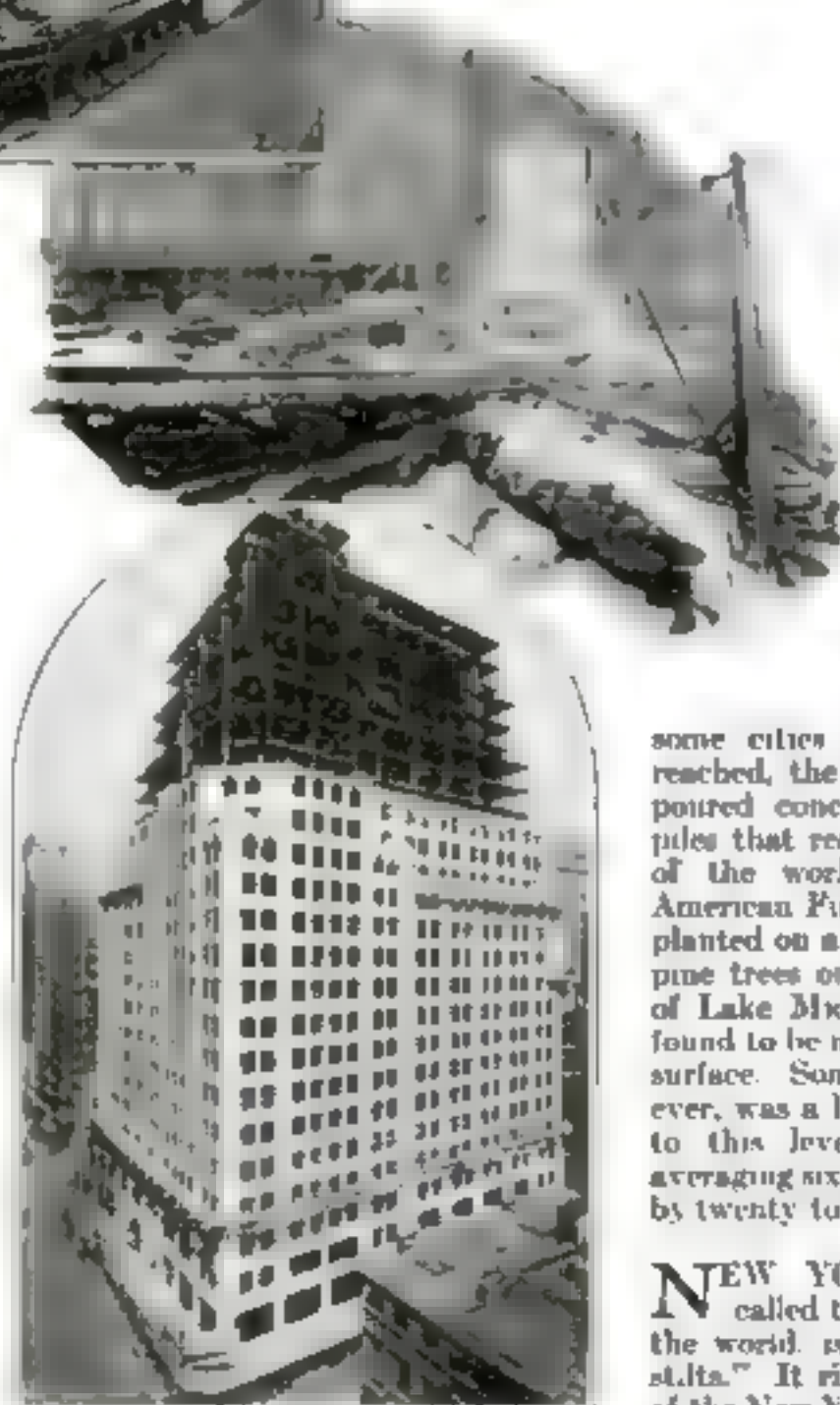
ONE of the mightiest of skyscrapers—the New York Life Insurance Building nearing completion on the site of the old Madison Square Garden—stands knee-deep in the biggest hole ever dug into the vitals of Manhattan Island.

Beholding it, one marvels at the engineering magic that reared this vast pyramid of steel and stone, surmounted by a tower that reaches 610 feet into the sky. Yet its visible greatness is only half the story. The other half lies hidden deep in the rocks where the giant's feet are firmly planted.

This building, like most modern skyscrapers, began as a hole in the ground. To erect it, men first had to dig for it. Visiting the site a comparatively few months ago, you would have looked down into a great gash in the earth seventy feet deep and nearly two acres in area—a canyon in the heart of a metropolis.

FAR down in the chasm workmen, looking like pygmies, prepared the foundation. With dynamite blasts, chattering power drills and picks and shovels they cut clean and straight through solid rock. At the bottom they chiseled a level floor, and into this they cut a score of rectangular holes, which they filled with poured concrete. And on these concrete footings they distributed the tremendous load of the skyscraper's massive frame—in all, 24,000 tons of steel!

Cutting the foothold for a great building



Three stages of the Murray Hill Building operation in New York City that set a speed record of 81 working days. Top, left wrecking old mansion on site. Middle: Excavation two months later. Bottom: Four months later.

calls for as high a degree of engineering skill as does the erection of the structure above ground. Every step is planned and charted precisely, before a stroke of work is done. Then men with diamond drills drive down through clay, earth, gravel and rock, searching for bottom solid enough to support the enormous weight of the building.

MANHATTAN Island's backbone of solid rock simplifies the problem, but in

some cities where bedrock cannot be reached, the feet of skyscrapers rest on poured concrete pillars or on wooden piles that reach down to hardpan. One of the world's largest buildings, the American Furniture Mart in Chicago, is planted on a veritable forest of southern pine trees on "made" land at the edge of Lake Michigan. The first rock was found to be more than 110 feet below the surface. Some seventy feet down, however, was a heavy layer of hardpan, and to this level 7,500 pine tree trunks, averaging sixty feet in length, were driven by twenty-ton blows of a giant pile driver.

NEW YORK'S Graybar Building, called the biggest office building in the world, is another unusual "city on stilts." It rises directly over the tracks of the New York Central Railroad at one of the world's busiest railway centers, while trains rush back and forth among its legs of steel and concrete. Supporting the building are (Continued on page 126)

Beating Death at the Sea's Bottom

Thrilling Exploit That Won Eadie a Medal as Hero
of S-4 Disaster Only a Sample of Divers'
Perilous Tasks—How Ellsberg
Twice Faced Death Below

By

ROBERT E. MARTIN

ONE of America's highest awards for valor, the Congressional Medal of Honor, is to go to a new hero—Chief Torpedoman Thomas Eadie, veteran deep-sea diver of the Navy. It is a tribute to the almost superhuman skill and courage of the man who, when the submarine S-4 sank off Provincetown, Mass., last December, risked and all but lost his life, first in an attempt to carry aid to the six men imprisoned in the submarine, then to rescue a fellow diver trapped in the muddy depths.

Eadie's part in that heart-breaking battle against the fury of a storm and the treacherous muck of the ocean floor adds an inspiring chapter to the record of one of the most hazardous of all professions, one which daily calls upon resourceful men to face and conquer death beneath the waves.

More than twenty-four hours had passed since the S-4, dealt a death blow by the destroyer *Panming*, had plunged to the bottom with her crew of forty souls. And with the arrival of the salvage ship *Falcon* in the morning the labor of rescue had begun. Eadie had been the first diver down. Dropping a hundred feet through icy water to the wreck, he had heard the tapping signals that said six men were alive in the torpedo room.

And now, as the gale rose in fury, Chief Torpedoman Michaels—"Mike" they call him—was down in that wet, cold blackness, trying to attach a hose that might carry fresh air to the imprisoned men. The *Falcon*, her decks slippery with frozen spray, strained perilously at the hawsers that held her to a pair of mine sweepers. If they gave way, so would Michaels' air hose and then

HALF an hour had passed since Mike, volunteering, had gone over the side; now he signaled for help. Eadie was exhausted and asleep. Wakened, he leaped from his bunk, rushed into his two-hundred-pound diving suit and, with wire cutters, knife and submarine lamp, slid into the sea.

He found the helpless diver lying face down on the forward deck of the submarine, his lamp useless with its wires fouled and his tangled air hose and life line on top of him, holding him down. In the beam of his own lamp he saw Mike's air hose was caught in two places—on the starboard side by a jagged, U-shaped piece of broken angle iron and on the port side by a steel plate evidently torn from the *Panming* in the collision.

Eadie forced his lamp into Mike's free hand, thrust his helmet close to his com-



Thomas Eadie, deep sea diver, who fought a desperate and successful battle to save his comrade Michaels, helpless on the S-4 wreck

rade's and shouted, "Hold it for me!" Mike tried, but he was only half conscious, and his uncertain hand flashed the rays into Eadie's eyes. Eadie reclaimed the lamp and telephoned to the *Falcon* for a hacksaw, which came down tied to a heavy shackle. Fearful of breaking the precious blade, he sawed slowly for an hour while the chill crept into his bones and numbed his hands.

AT LAST the iron was cut off. Eadie lifted the air hose free. Mike started to rise and swayed crazily. Eadie shouted a warning, "Wait! You're caught on the other side!" and climbed off the port. In a minute he had the rest of the line free, but his troubles were not ended. Climbing back he ripped open a leg of his diving suit on another piece of broken metal and the water, two degrees above freezing, soaked him to the chin, though it could not reach his helmet. By the time he reached the S-4's deck he knew that neither he nor Mike could hold out much longer.

"Haul in Mike's line," he telephoned to those on the *Falcon*.

As Michaels began to rise, Eadie felt

a tug on his own line. The two lines were tangled.

"Stop!" he yelled, and, summoning his remaining strength, he caught Mike in his arms and passed him around his own body until the lines were clear.

Believing they would do better by using the descending line near the conning tower to help them up, Eadie made for it, beckoning Michaels to follow. But when he arrived there and looked back, Mike had vanished!

They pulled Eadie to the *Falcon* and rushed him into the decompression chamber where emerging divers are placed to prevent the dreaded caisson disease, the "bends." Michaels lay there unconscious, wrapped in a blanket. The buoyancy of his diving suit had sent him to the top, and he had been hauled aboard. His struggle in the depths for nearly three and a half hours, followed by his swift ascent, had caused a bad case of the "bends." The increasing violence of the storm made further diving impossible, and so the *Falcon* hurried the stricken diver to a Provincetown hospital, where his life was saved.

THE S-4 disaster and the subsequent failure to rescue its six survivors has aroused nation-wide criticism of the Navy for what has been termed carelessness for the safety of submarine crews. Yet only praise has come for the divers who gave their best against the buffeting storm.

Eadie, a shy brown-haired hero of forty years, would tell you modestly that such adventures are daily chores in his profession. Thousands of divers the world over are on the job every day, clearing ship channels of wreckage, salvaging fortunes in sunken treasure, exploring the strange life of the deep, mending broken cables, and performing countless other hazardous tasks. Every important shipping center has its expert divers. New York harbor alone employs forty. None of our marvelous underwater railway tubes or vehicular tunnels could have been built without their fearless skill.

But even the most courageous could not perform their feats were it not for modern inventions which aid them. Eadie might tell you, for example, that the rescue of his comrade would have been hopeless without his 1000-watt undersea lamp which sent its beam through the water for ten feet, even on the blackest night. This lamp was developed from the experiences of divers who raised the sunken submarine S-51 a little more than two years ago. So also came the undersea cutting torch devised by Lieut.



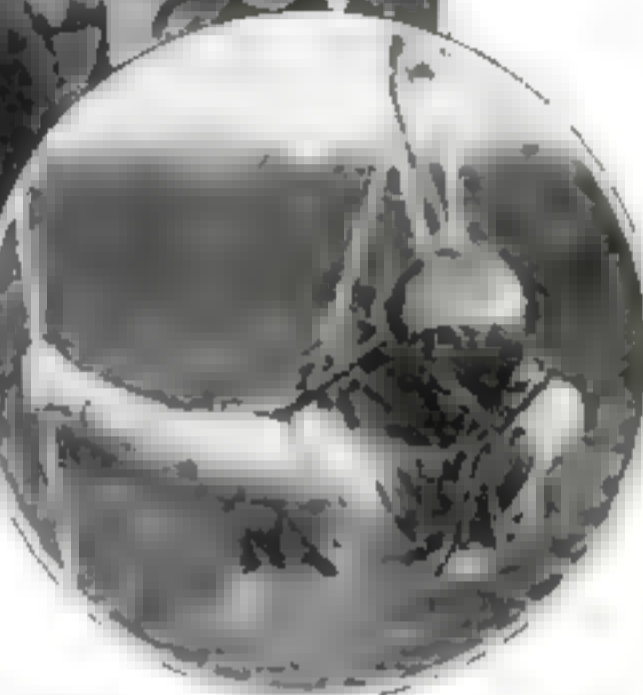
Diver Frank Chiley being dropped off the *Falcon* making his last descent in an effort to save men in the sunken *S-4*. Right: Lieut. Commander Ellsberg being hauled aboard after facing death when sunk to his neck in sea mine

Commander Edward Ellsberg, who raised the *S-51*, and, now retired from the Navy, volunteered his services in the *S-4* salvage operations. An envelope of compressed air surrounding the diver enables it, when submerged, to cut through heavy steel. A German invention uses oxygen in the same way.

Ingenious methods of supplying compressed air to divers have greatly lengthened the time they can work safely in the depths. And this time has been extended further by the use of helium gas which, when added to oxygen in the air, serves to prevent the bodily conditions that cause the "bends."

STILL other inventions include heavy diving armor in which men have been able to go down hundreds of feet, cylindrical diving bells or chambers for making deep-sea explorations, and strange cars which move on wheels over the ocean bed.

Submarines are really highly developed diving bells, yet with all their wonderful mechanism there has not yet been



applied, to American submarines at least, any trustworthy speedy means of rescuing crews sent to the bottom in disabled craft.

A number of such devices have been invented or proposed. Accompanying illustrations, for example, show an ingenious rescue tube, devised by J. M. Cottrell, of Boston, through which air, food, blankets and electric wires for heating might be passed to imprisoned men. This would be achieved by an arrangement of double circular plates in the side of the submarine. To attach the tube, an outer plate would be opened. The tube then would be pumped dry, after which the inner plate would open, giving access to the interior of the submarine.

Other inventions include escape chambers of various types containing air under pressure equal to the pressure of the air surrounding water. Attached to a sub-

marine, such a chamber might permit divers to cut a hole in the hull, through which the crew might escape into the chamber. There they could be supplied with diving suits, in which they could be hauled to the surface.

Last month's issue of *POPULAR SCIENCE MONTHLY* told of recommendations by Representative Anthony J. Griffin for the installation of grapping rings by which lifting cables might readily be fastened to a sunken submarine.

In the absence of any such aids, the plan of rescue undertaken following the sinking of the *S-4* was to attach air lines to blow valves in the submarine's ballast tanks. It was hoped that by blowing the water from the tanks, enough buoyancy might be given to raise the bow of the ship, containing the torpedo room, which held the six survivors. But the ballast tanks had been punctured by the collision and the air escaped as fast as it was blown in. The next attempt was that of Michaels to supply fresh air to the torpedo room by attaching an air hose to a compartment air valve.

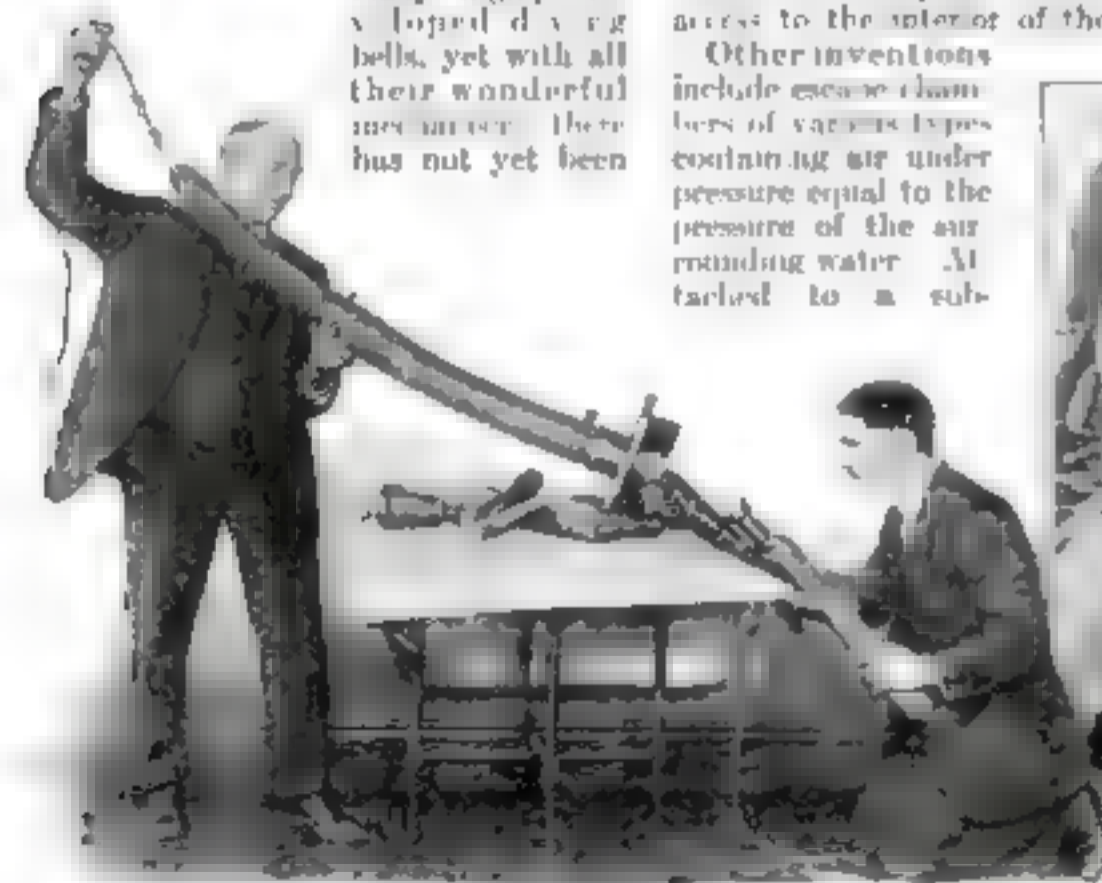
THE only remaining chance of salvage, then, was to employ the method used by Ellsberg in raising the *S-51*—to tunnel beneath the submarine, pass heavy chains round it, and lift the wreck with huge pontoons. At this writing divers are at this task.

Twice during the first efforts to reach the *S-4*, Commander Ellsberg barely escaped with his life. On his first dive a faulty valve in his helmet partly cut off his air supply. When hauled up he fell to the *Falcon's* deck in a convulsion of agony—a severe attack of the "bends." After spending some time in the "Iron Doctor," the decompression chamber, he emerged for a second plunge.

This time a jerk on his life line threw him off the *S-4* into a deep mud hole. As he fell, a piece of wreckage tore a hole in his glove and water poured into his suit. The sticky mud sucked him down until he was wholly enveloped.

Valving air into his suit he gained enough buoyancy to get his head out of the mud. And then he was hauled to safety.

Such were all the men who fought for the drowning prisoners of the *S-4*.



Left: J. M. Cottrell, inventor, sending rolled blanket through his safety tube to a man supposed to be in a submarine. Above: Cottrell being hauled up in tank that demonstrated device

Fontaine Fox

Insists He Is an Inventor

HERE IS AN Article That Will Make You Smile and Then Stop and Think. In It Mr. Fox, the Newspaper Cartoonist Whose Toonerville Trolley and Other Caricatures Amuse Thousands of Us Daily, Explains What an Understanding of the Human Interest in Mechanical Things Has Meant to Him

IF THERE is an inventors' guild I can qualify for membership, but I couldn't be an officer because I am too busy inventing. Edison, McCormick, Marconi, Bell, Ford, and the forgotten genius who first devised a folding bed are all right in their way, but the lot of them did not invent so many things as (let the band sound flourishes and ruffles) Fontaine Fox.

Every day in the week I have to invent a cartoon. Now your first impulse may be to laugh, and I hope you obey it—because a comic artist's primary function is to make people laugh—and when you have finished I will try to convince you that I am an inventor in the mechanical sense of the word.

Because we employ language somewhat carelessly, invention has come to mean in the average man's mind the creation of some new mechanical contrivance instead of meaning the production of anything by the exercise of the imagination. However, I am willing to rest my claims as an inventor on the mechanical contrivances which I frequently devise to assist certain fanciful characters I use daily in my drawings.

I DON'T know what Tomboy Taylor, one of my characters, would do without that simple little power plant, the bed spring; and the spring at the base of the trolley pole on the Toonerville Trolley is, if you will pardon a pun, a well-sprung of ideas. I have had the Skipper using its power to lift his minnow net out of the creek, to lift water in a



Fontaine Fox, cartoonist-inventor, at work in studio-laboratory

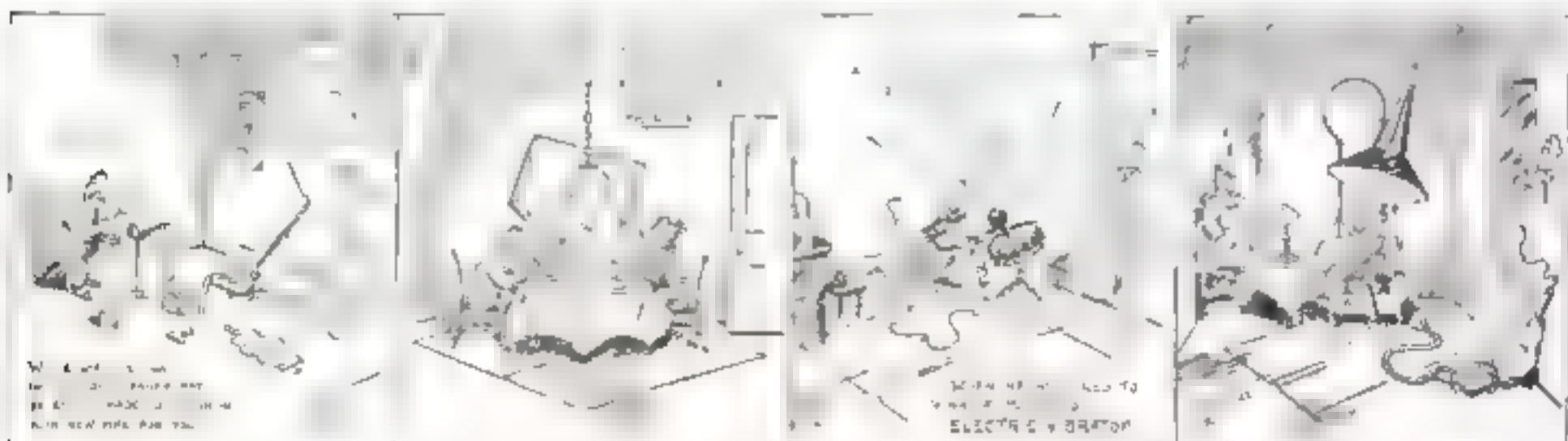
simple irrigation device from the pond on one side of the track to his garden on the other, and, slickest of all, to lift his cumbersome shovel when forced to clear snow from the tracks. I might not be able to patent those ideas; nevertheless they are inventions, and some of them I have actually made and used.

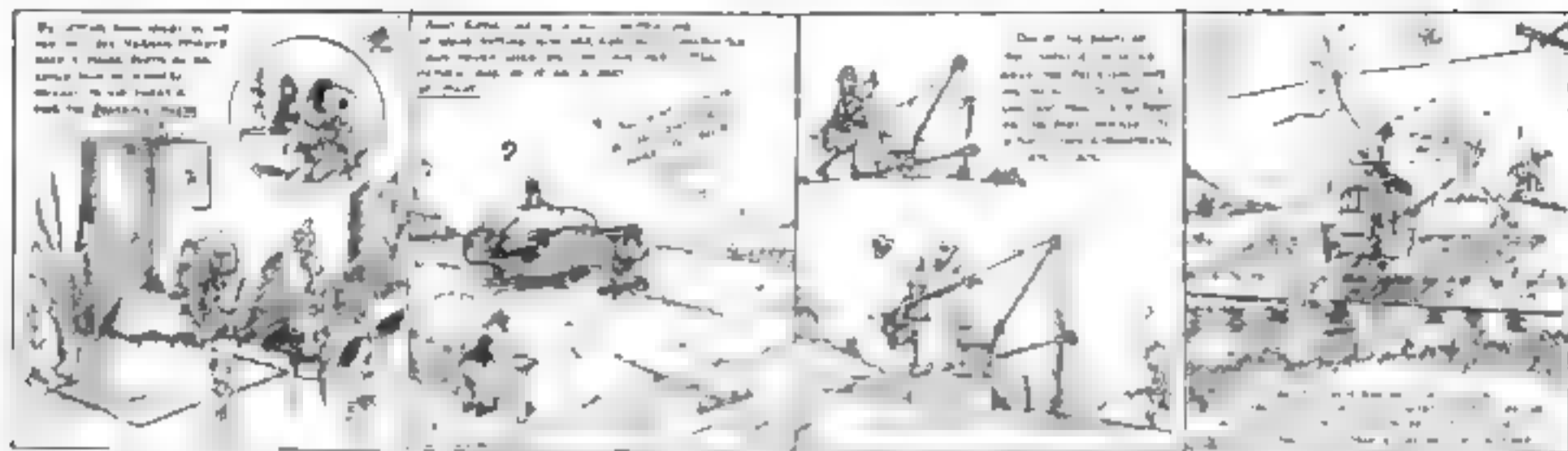
As a boy I developed a keen interest in tools and the principles of mechanics. I made Dan Beard traps and learned by heart a handbook on how to be handyman in the house. Better than this, though, I had an uncle who collected tools as other men collect antiques. He was Judge George DuRelle of Louisville, Kentucky, and his collection of tools

made a mechanics' heaven in the upstairs chamber where I was allowed to play. Better than that, I was instructed by Judge DuRelle in the use of the tools, and of these mechanisms I build now are mostly on paper, and generally fantastic, nevertheless I want to shout that all of them would work. Some of them have!

LET me defend my position as an inventor as seriously as possible now by recalling an idea that occurred to me one time when I watched Mrs. Fox try to administer some medicine to a reluctant Fox baby. I played with that problem of giving medicine to squirming babies for several hours and then produced a drawing that had for a caption: "Tomboy Taylor claimed that she had not made the baby cry, because he was already crying for a drink of water." The picture showed Tomboy's mother hanging weakly to the portieres and gazing with horror upon her daughter squirting a stream from a water pistol into the open mouth of the youngest Taylor child, squawling on the floor. Now that was my idea for a comic drawing, but I think I could get a patent on a graduated medicine gun if I should apply for it at Washington.

One of the practical devices I figured out for small boatmen is perfectly feasible. One day I watched a flounder fisherman in Long Island Sound bailing frantically with a tin can at intervals of rowing toward shore to escape a storm. I conceived an invention on the spot, and employed it in a drawing that showed the Village Halfwit rowing in a small boat





with something resembling the handle of a lawn mower projecting above his head, while its shaft was strapped to his back. Bilge water was squirting from a hose hung over the gunwales. The caption explained that the Halfwit, having come into possession of an old force pump, had rigged up a device to make the act of rowing bail out the boat.

Another eminently practical invention of mine dates back to my boyhood when I was sometimes made to turn the family ice cream freezer. I actually built this one before I used the idea in a cartoon. My drawing showed a stout ice cream freezer with two cranks, each fitted with a pedal from an old bicycle. The same dismantled vehicle had provided a saddle and handlebars. Except that I did not provide a saddle, the ice cream freezer I equipped with pedals was precisely like my drawing and it did not tire the arms, although it was a little tough on the legs.

The great advantage of any Fox invention is the simple character of the mechanism, as, for example, the bed spring device whereby the little Murphy boy makes it possible to seesaw with his pup. The child sits at one end of the plank placed astride a sawhorse. At the other end is a soap box in which may be placed a counterweight. The bed spring on the underside of that end of the plank gives the kick that compensates for the reflexes in the muscles of the operator. I call this the "one-kid seesaw", and my children have used one that I made for them.

SOME months ago I saw in a New York store an ingenious seesaw for babies, called a Jimmy Jumper. There was a sort of breeches buoy at one end to hold the kid and at the other a stout spring was made fast. It was a better seesaw than mine. A kid could not escape from it. By chance I discovered that the inventor was another cartoonist, an acquaintance, Albert T. Reid, who holds

patent rights on several inventions now on the market. It did not surprise me to discover that a cartoonist was also a practical inventor, because the average cartoonist's mind functions like an inventor's. There is another reason, though, that has impelled me to struggle for humorous effects with strange contraptions, as when I draw the Village Traffic Officer in deep chagrin because his wife has made him mount his "stop and go" semaphore in her churn so that he makes butter while he controls traffic. That reason is that most Americans seem to be mechanics at heart. America is what it is today because of the mechanical instincts of its people, and so I determined to address much of my work, intended to be humorous, to people in whom that instinct is awake. An analysis of my mail indicates that these mechanical devices have increased the popularity of my cartoons.

SOME of my inventions are just common sense applications of homely devices to troublesome situations. For example, I deserve credit for having thought of more uses to which vacuum cleaners might be put than have been dreamed of by the manufacturers. In a series of drawings, *Hints to Husbands*, I have shown how the suction cleaner, while wife is away, may be easily made to break in a new pipe—just an extra length of rubber gas tubing, one end fitted over the stem of the pipe and the other into the hose of the cleaner. And I have shown the same husband using the suction to take potato bugs off the vines as clean as a whistle.

Back in the days when carpet sweepers were regarded as the ultimate in household labor-saving implements, I had Vernon McNutt, the great uncle of the Village Halfwit, using fountain pen methods to whitewash a fence. He poured his whitewash into one pocket of a carpet sweeper. It was just my sense of fairness

that kept me from repeating that cartoon with the vacuum cleaner motif in recent years. Then one day I discovered that that is actually the way fences are whitewashed in modern times. Instead of slapping it on as in Tom Sawyer's day, and (later) my own, the whitewashers blow it on with a sprayer.

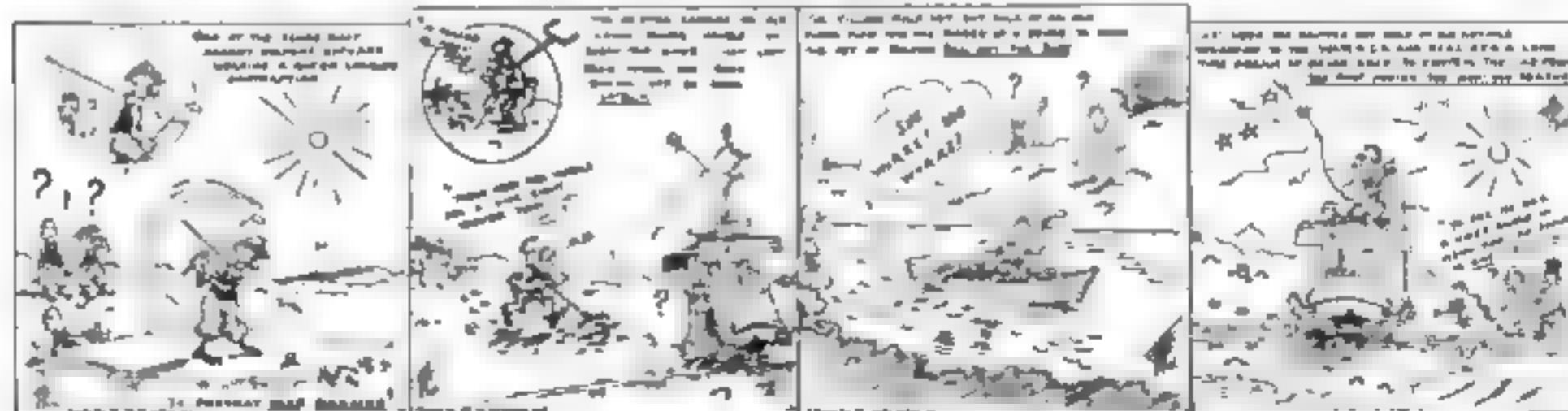
UMBRELLAS? I have invented more contrivances with umbrellas than Robinson Crusoe ever did with goatskins. I am not referring to episodes as that in which Tomboy Taylor tears up the beautiful little Christmas parcel to make a shinny stick. I am thinking of one of the sights of Toonerville, which is Old Man Addicks carrying his famous windy day umbrella. It is merely another Fontaine Fox invention, an umbrella with two handles so that when a high wind turns it inside out, Old Man Addicks just takes hold of the other handle and continues to get shelter.

There are always fools in the world who think it is funny to hand out exploding cigars, so I drew a picture of a yokel enjoying such a gift cigar in complete safety. This device included a bamboo tube extending through an umbrella parallel to the handle so that a cigar inserted in the ferrule end might be safely smoked from behind the shelter of the umbrella.

As the master mechanic of an electric railway company, the Toonerville Trolley That Meets All the Trains—I have to be pretty skilful at improvising ways of keeping the rolling stock (one antediluvian car) running and in dealing with myriad traffic problems. Worse than that, I have to create the traffic problems, because the Toonerville Trolley would go into a receiver's hands if it were not for those odd situations which I must invent by way of justifying its existence.

Sometimes the Trolley has to run through floods. That called for some sort of gage with

(Continued on page 187)



Hypnotism Gives Aid to Surgeon

Patient Spared Suffering in Chicago Doctor's Astounding Experiment with Anesthesia—Will Profession Adopt His Method?

By GROVER C. LANGE

IN ST LUKE'S HOSPITAL in Chicago, a few weeks ago, a young woman facing a major operation for abdominal adhesions was hypnotized as she lay on the operating table. For almost an hour she rested in wide-eyed hypnotic sleep, while Dr. Harold G. Jones made an incision, severed the adhesions and completed the operation without the use of any drug or anesthetic. And when the patient was awakened, she declared she had suffered no pain whatever! Nor did she experience the nausea which commonly follows the administration of ether. The operation was successful, the patient swiftly regained health, and no apparent harm resulted from her unusual experience.

This remarkable surgical experiment, the first of its kind attempted in the United States in many years, has aroused leading medical authorities to the possibility of reviving the scientific practice of hypnotism as a substitute for anesthetics, particularly in cases where a patient's heart might be affected by drugs, or where there would be likelihood of severe after effects.

Just what was the procedure by which the hypnotist was able to produce such a deep sleep that the subject felt no twinge of pain from the knife?

In the operating room was no suggestion of the occult or magical. Equipment and methods were surrounded with the scientific care always given to such cases in a great hospital. Attending the patient were the surgeon, the usual nurses and a skilled hypnotist, Dr. Alfred P. Solomon, a member of the hospital's neurological staff.

The young woman, having freely consented to the use of hypnotism, was made as comfortable as possible, so that she might relax completely.

"I want you to go to sleep," said Dr. Solomon. "You are going to stay asleep until I clap my hands—like this—and say, 'Now wake!' Do you understand?"

The young woman repeated the instructions.

Now an attendant darkened the room slightly, and while the patient fixed her gaze on a certain object in the room, the hypnotist began talking to her soothingly. Monotonously he passed his hands slowly before her staring eyes.

"Sleep." He repeated the word softly, again and again. "Think of my moving hand. Think of gently drifting off to sleep."

Not once did his eyes leave hers. Ten minutes passed. Slowly the patient's eyes lost the luster lent by waking thoughts, she seemed to be dreaming, open-eyed. The hypnotist commanded:

"Now, sleep!"

At once the subject's eyes lost the dreamy look and became fixed in an unwinking stare.

THE surgeon stabbed the bright, sterile point of a needle into the patient's arm. Not a quiver of response nor sign of pain. All sensation apparently had vanished. Now the operation. In the silence of the room the surgeon worked with deft fingers. When he finished and the wound was closed and bandaged, the

hypnotist clapped his hands sharply. "Now, wake!" he commanded.

The young woman slowly opened her eyes and looked up in surprise.

"It's all over," he assured her.

"All over? But I did not know."

"No, of course not. Now all you have to do is to be still and get well."

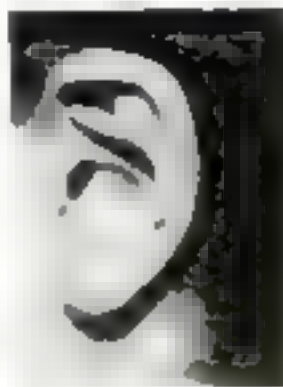
What happened in this case, experts say, is typical of hypnotic technique in surgery. Strange and revolutionary as it may seem, this practice is not a new discovery. Almost a hundred years ago it was used fairly extensively, one of the most famous practitioners being James Esdaile, a Scotch surgeon. Today it is still in more or less common use in continental Europe. In the United States, however, the introduction of chloroform in 1848, followed by other anesthetics, almost entirely replaced hypnotism. Moreover, its use as a plaything by magicians and fakers brought it into such ill repute that medical men would have none of it. The success of the Chicago operation suggests now that the practice, in the hands of skilled men, again may be raised to the status of a merciful instrument of science.

The fact of hypnotic power is universally recognized. A skilled hypnotist can put nine out of ten persons into the mysterious half-sleep. And no less an authority than Dr. James Rowland Angell, president of Yale University, says: "By making appropriate suggestions, the sense organs may be rendered seemingly quite insensitive to stimulation. For example, the skin may become impervious to the pain of burning or pricking or cutting."

Physicians say the practice brings no harmful results. Although a subject, once hypnotized, can be hypnotized more easily a second time, the popular belief that the will is weakened is declared to be unfounded. Again—contrary to general belief—a patient in the hypnotic sleep cannot be induced into acts which he or she would consider wrong when awake.

Reputable practitioners warn against the abuse of hypnotism, and especially against its use for mere sport. The human mind, they point out, is a most delicate mechanism, and a little unwise tampering may throw it out of kilter.

Your Ears Prove Your Identity



IF YOU are acquainted with twins that you cannot tell apart, look at their ears. No two pairs of ears in the world are alike, says S. Nelken, a noted German criminologist, who has recommended systematic records of ears—like those of fingerprints—as a new method of identifying criminals.

The twin sisters in the accompanying illustrations, for example, are remarkably alike, but their ears show marked difference in the inner convolutions.

Ears are of countless sizes and dimensions, as distinctive as a man's signature. They remain the same throughout life. Only surgery can change them.



In a little office a few men quietly control the destinies of this train and thousands of others. They are the dispatchers.

Keeping Trains Out of Wrecks

Hair-Raising Incidents We Never Hear Of and Ingenious Machines Being Used to Protect Us

By JESSE F. GELDERS

IN FOSTORIA, Ohio, a man sits before a queer machine looking like a combination telephone switchboard and miniature railway. Lights flash—the operator moves markers along diagrams of railroad tracks and pulls levers. On sectors of track above the diagrams switches open and close.

Railroad men all over the country are watching with intense interest the efficiency of this unique instrument. It is a recently constructed dispatching machine, first of its kind, being used on the Ohio Central Lines of the New York Central.

Supplanting the old system of telegraph, telephones and orders written by station agents, it enables the dispatcher to direct all trains himself, manipulating signals and switches along a forty-mile stretch of road. The flash of lights beneath the track diagram informs him of each train's advance, and he moves the marker which represents it. When two trains must pass, he pulls a lever which sends one into a siding. As the switches on the railway open and close, those on the diagram move correspondingly. The same operation governs the signals which direct the train crews to stop or proceed.

Special interlocking devices make it impossible for the dispatcher to order a train to advance unless the way is clear.

BESIDES the vital safety advantage for the thirty-four trains which operate daily over this territory, the amazing new system makes greater speed possible. When, with the switches operated by the dispatcher, a train takes a siding, it makes only *one* stop instead of three. Each month the dispatching machine eliminates some 4000 orders that would have to be given under the old plan.

The remarkable machine keeps a record of all train movements. Each station and switch is listed on a sheet, and as the train passes a check is made. Horizontal lines across the sheet represent the time at two-minute intervals, and a clock device moves the sheet so that as a train advances, the series of checks which represent its progress range diagonally downward. When two trains pass, the diagonals cross. When a train is delayed, the mark extends vertically downward.

In emergency and in handling work trains the dispatcher communicates by telephone, as of old.



Courtesy N. Y. Central Lines Magazine

The new dispatching machine, now under test, that all railroads may eventually use. The dispatcher directs trains electrically by levers.

RAILROAD men believe this system, or a similar one, is destined to spread extensively, but they insist that the old train order system of dispatching is bound to remain on some roads for many years. "But that has undergone refinements too," says C. J. Brent, a veteran dispatcher on a large eastern railway. "You'll find methods much better than they used to be. There aren't so many thrills now, but in the old days—"

"I remember the case of a dispatcher up in New England. His heart jumped into his mouth when he saw he'd issued a 'lap order,' giving two trains the right-of-way over the same

track! He had sent the eastbound running head-on toward a freight coming from the other direction.

"It was Sunday and all communicating stations were closed, except every fifty miles, making it impossible to reach either train after he let them in on that stretch of single track. But he didn't lose his head. He dashed for a public phone, and began trying to call up people he knew along the line.

"Finally he got a station agent's wife, living near the track. She snatched up a tablecloth and by waving it violently stopped the train. It went into a siding and nobody on the other train, which passed, ever knew anything had been wrong.

"Out on the line," went on Brent, "a train crew may see only a few hundred feet ahead or to the rear. They are blind to what may lie around the next curve, or beyond the tunnel. But they know that the dispatcher sees—on his train sheet. They must depend on him—for their lives and those of all their passengers."

Many lines have the additional precaution of a automatic safety signals, but occasionally, in spite of them, the unexpected happens. There was the case of a runaway locomotive on a certain New York road.

"SOMEHOW the throttle was jolted," Brent recalled, "and it left the roundhouse track and got out on the main line. There was a job for your dispatcher! A wild engine doesn't obey stop signals, automatic or otherwise! The dispatcher notified every station and towerman along the way. When the runaway passed the first tower, a man was ready to jump on. But the speed was too great.

"A passenger train was nearing the next station. The dispatcher ordered it into a siding. Five other trains had to be put on sidings or switched to other tracks. The runaway traveled eighteen miles before failing steam slowed it sufficiently for a trainman to swing aboard and stop it; but the dispatcher kept the traffic safe and moving with only slight delays."

The dispatcher's ability to avert an accident in this case shows how modern railroading is constantly developing ways to prevent wrecks. Mechanical devices help. Operating systems are so planned that a collision can rarely occur as the result of one mistake or failure of a mechanism. It takes a whole combination of blunders or mechanical failures now-a-days—all coming at exactly the same time.

Few people realize just how valuable the addition of one more safety check may be. Suppose by the law of averages a man or a device fails once in every 100 operations—of course mistakes are in fact much less frequent than this. With

such an average, the odds would be 100 to one against an accident.

Now devise a system whereby no mishap can occur unless there are two simultaneous failures. The odds become, not 200 to one, as might at first appear, but 10,000 to one—because, by the law of averages, the first man or device will fail 100 times before the second suffers a simultaneous failure.

A runaway locomotive in New Hampshire once gave a thrilling problem to a dispatcher. Word came that the engine had shot out of the roundhouse carrying only a laborer. Nobody knew whether he was insane or drunk, or had started it by accident.



For emergencies, and in operation of freight work, trains moving cars about yards, trainmen communicate with dispatchers by trackside telephones.

A passenger train was approaching a station, seventeen miles from the wild engine's starting point. The dispatcher ordered it stopped. Between the runaway and the passenger was a derail siding, ending at a river bank. The dispatcher had to think fast. He ordered the passenger engine to uncouple, race to the derail switch and throw it, dumping the runaway into the river.

The switch was thrown, but the wild

locomotive didn't appear. They found it stalled, eight miles down the track, from lack of steam. The laborer was taken out of the locomotive's cab, stiff and white from fear. A leaky throttle had started the engine on its wild ride.

Lack of precautions, coupled with individual errors, has proved costly in times past. Back in 1914, five employees were killed and 126 passengers were hurt in a wreck on the Hocking Valley, near Starr, Ohio.

THE dispatcher had issued an order which read: "No. 134 eng. 74 meet No. 137 eng. 73 at Starr. No. 137 gets this at Starr."

Unfortunately, No. 137 did not get it at Starr. Somebody forgot to deliver it. When No. 137 reached Starr No. 134 was nine minutes late and hadn't appeared, so No. 137 went on and, between two curves, the two engines crashed and went rolling down an embankment.

"Sending that meet order to the meeting point instead of to some point further back on the line made it possible for one man's oversight to cause a wreck," Brent pointed out. "Unless there are automatic signals for protection, dispatchers try to avoid this risk whenever possible, though of course it's perfectly safe as long as everybody is on the job."

There was a case on the Frisco, in 1917, with a somewhat different set of circumstances. The dispatcher at Oklahoma City issued two orders. Order No. 88 read: "Extra 1322 east has right over No. 407 Depew to Kellyville." No. 81 read: "No. 408 gets this and meet 407 at Kellyville."

No. 407 was a passenger train, from St. Louis to Oklahoma City and Lawton. When it reached Kellyville, the engineer and conductor saw two other trains on the siding. One was No. 408, the Lawton to St. Louis passenger. The other was Extra 1343, but the engineer of 407 took it to be Extra 1322. A fatal error. Extra 1322 was still steaming eastward, with the right-of-way to Kellyville.

NO. 407 PROCEEDED west, running thirty miles an hour until the engineer was startled to see the other train 2500 feet away, rushing toward him. He shut off steam, applied brakes and sand, sounded the whistle and jumped. Twenty-three persons were killed and fifty-two were injured when the trains crashed.

It was stated after the investigation that the wreck might not have occurred if there had been a rigid rule requiring the dispatcher, after giving "meet" orders, to place a duplicate, or "middle order" at the meeting point as a final precaution. In that event, the operator at Kellyville probably would have caught the error and held No. 407 until Extra 1322 arrived.

(Continued on page 131)



Yards at eastern end of a great railroad. Through this network of tracks the dispatcher is responsible for the movement—safely and on time—of 700 passenger trains a day.

Flying Wounded Troops Through Snipers' Bullets

By HYATT E. GIBSON

TWO airplanes in Nicaragua, one circling like a wasp to fight off attackers, the other roaring into the air with a load of wounded United States marines, wrote a new chapter of heroism and resourcefulness into the annals of aviation the other day, and showed that an airplane could serve as a messenger of mercy as well as an instrument of warfare.

Speedy transportation out of the enemy's stronghold over impassable mountainous country to the base hospital at Managua, Nicaragua, saved the lives of at least nine marines, who, like their comrades, were engaged in the conflict of American forces with the rebel general Sandino. Two wounded native soldiers, too, were later carried to safety by the hero of the exploit, First Lieutenant C. Frank Schilt, a crack Marine Corps pilot, who has taken a Navy plane to second place in the Schneider Cup Races. He shares the latest honors with Lieutenant Lamson Scribner, who kept guard with his darting fighter plane in the face of heavy machine gun fire.

HARDLY had the smoke of battle cleared over the little town of Quilali, after a fiery engagement between American and rebel forces, when U. S. planes, flying overhead, picked up from ground troops the urgent message that fifteen marines lay wounded, nine seriously. Only immediate removal to a hospital could save the lives of many.

That meant taking them from the deep hole in which Quilali lies, and over the rim of rugged mountains that border it to Ocotal, the last outpost of civilization, twenty-five miles away, whence they could be rushed by cabin plane to Managua. Not even bull carts can penetrate the mountain fastnesses around Quilali; transportation is on foot or by pack mule. But the bandit forces surrounded the mountain town. How, then, to get aid?

Airplanes! What if there was no landing field in Quilali? A fifteen-foot road, bordered with gullies, worms its way through the town. Widen it! Overhead, marine planes swooped. To the American troops below they dropped picks and shovels. While eager hands seized them and set about razing trees, burning the houses on one side of the road, and leveling ground to make the improvised landing field, Lieut. Schilt at Ocotal made ready for his flying dash over the mountains. Oversize tires went on his Corsair plane to take the punishment of the rocky field he must land on. At last word came



The smallest airfield landing that Schilt made in ten days in one day in a rocky field, very large than a city lot and surrounded by mountains, trees and a ditch



Lieut. C. Frank Schilt, who battered his plane almost to pieces with rocky landings in carrying 15 marines, wounded in Nicaragua, to safety

that it was ready, and he was off flying through fog, rain and clouds.

From his plane, skimming over Quilali, Lieut. Schilt surveyed the field he must land on. It was a rough, uninviting clearing a bare 300 feet long and seventy wide, terminated by a high bluff at one end and a ditch, trees, and a mile-high mountain at the other. He dove at it and rose again; he couldn't make it. It seemed impossible. Again he tried, and this time deliberately set his plane down on the bumpy earth. Marines came running toward him. The plane bounced thirty feet in the air, settled, bounced again, and came to rest in the ditch at the end of the "field."

"**MY** GOD, Schilt," cried Lieut. Gould of the ground troops, first to reach him, "an angel from Heaven would be no more welcome than you!"

Was the plane wrecked? "I expected to find half of it spread out on the ground,"

Schilt said. But it was whole. New for the night back to Managua. Round severely wounded in the road was the first passenger in the air ambulance. Two sturdy marines bent the wing tips for the take-off and released them at Schilt's signal. Others stood guard with machine guns, rifles and pistols to repulse any surprise attack. The rebels lay watching the plane descend, and their machine guns were already beating a savage tattoo.

OVERBOARD he jumped Schilt's plane to catapult to effect into air. Another battle and he was off. Over the mountains roared the plane. Schilt was wounded, but Lieut. Scribner, his flying escort, fired down at menacing snipers as they passed. Ocotal at last, and the wounded marine, tenderly lifted out, was on his way to the hospital.

Ten times in all that day Schilt braved the hail of snipers' bullets and the perils of the almost suicidal landing at Quilali to bring out the rest of the wounded. His eighth landing carried away the tail skid, he took off without one and landed at Ocotal on the rudder. On the ninth descent a wing strut buckled and Schilt straightened it with an axe.

For the tenth and last trip he wrapped the offending strut with a hasty bar of tape and wire, and without accident brought out the last of the wounded. Actually eighteen wounded marines were his passengers, the last sixteen of them two at a time, before Schilt completed what has since been termed one of the finest feats in military aviation. As if that were not enough for one day of heroism, Lieut. Schilt adds, in a matter-of-fact way, that after landing the last of the wounded at Ocotal, "we proceeded on a patrol flight over the bandit areas."

A Month's Harvest of New Ideas and Strange Facts



A machine that automatically analyzes chemicals fed to it, dispensing with the services of a human chemist, is the amazing invention of Dr. H. S. Hatfield, of England. The machine contains tubes and bottles of reagents; that is, chemical substances that react when they come in contact with the substance to be tested and record what it contains and in what quantity. The device is operated by electricity.

Latent discoveries and inventions in varied fields of science, and newest applications of knowledge gained by research—all of peculiar interest because of their direct bearing on our daily life—are recorded from month to month in these pages.

Airplane Cowboys Herd Reindeer

AIRPLANES are playing still another rôle. On the reindeer ranches of Alaska and northern Canada they are serving as swift mounts for the "cowboys" who ride the range.

Ralph Lomen, pioneer in the now rapidly growing Alaskan reindeer industry, reports that his head herdsman, riding a plane, recently completed in two hours work which ordinarily would require the services of seven herdsmen for a week.

"Magic Carpet" Aids Crops

DR. L. H. FLINT, of the U. S. Department of Agriculture, reports the success, in three years' experiments, of a "magic carpet" which, when spread over the soil, increases the yield of garden crops as much as 500 percent and more.

The carpet is of heavy waterproof paper. Covering all of the ground not occupied by the plant stems themselves, it increases the soil temperature, prevents loss of moisture, distributes water among the plants and smothers weeds. The increases in yield have varied from eleven percent for peas, to 516 percent for spinach. The lettuce crop was more than doubled, green corn trebled, and potatoes almost quadrupled.

Much of World Unexplored

SUFFERING bitter hardships, including cold of seventy degrees below zero, Russian explorers have discovered a



A method to sight and fire at a moving object—such as an enemy airplane—in 32 seconds with such accuracy that only one shot is required is claimed by Archibald Hanks, of London, shown here with riflemen testing his plan. With curious measuring devices—like wheels and parts of wheels—height, distance, speed and direction may be gauged, he says. Similar devices on the guns are set to conform, and through these the marksmen sight.

great 600-mile mountain range rising from trackless wastes of Siberia.

Within a few months an expedition of Tulane University, New Orleans, will plunge into unexplored jungles of Central America and Mexico, seeking ruins of ancient Maya cities which flourished 1,500 years ago.

There is a lot of the world that nobody knows anything about—many an untrodden field of adventure.

Social Brain Best

WHAT is the secret of success in life? A new answer to this old question was given recently by Dr. Fred A. Moss, of George Washington University, in a report read to a meeting of the American Psychological Association in Columbus, Ohio.

According to Dr. Moss, success depends largely on a man's ability to understand others and to get along with them. This quality, called "social intelligence," he declared, is actually more useful than any amount of knowledge.

Doctor Moss devised a social intelligence test, which he applied to several thousand persons in various occupations. The highest possible score was 160 points. The results showed business executives, as a group, stood highest with an average of 117; teachers came next, with 112; salesmen, 107; clerks and stenographers, 10; sales clerks, 81; nurses, 78; low grade industrial workers, 65. The highest record of all so far, 145, was scored by a college boy who expects to go into politics after graduation.

Brains Mean Death, Asserts Dr. Carrel

FOR centuries mortals have searched for the fountain of eternal youth. Will it ever be found?

Dr. Alexis Carrel, the great biologist of the Rockefeller Institute for Medical Research, thinks not.

"Death," he told the recent Race Betterment Conference at Battle Creek,

Mich., "is the price we have to pay for the possession of brains."

In remarkable experiments Doctor Carrel has shown that a single life cell, properly fed and nourished, is apparently immortal. Our bodies, however, are complex communities of many cells, reacting



How best to keep heat from "leaking" through the walls of your house in winter and from leaking into your refrigerator in summer is the question whose answer is sought by new tests by M. S. Van Dusen, at the U. S. Bureau of Standards. He is shown inserting various materials in a machine that records their efficiency in barring the passage of heat.

MECHANICAL Chemist Serves in Place of Experts — "Magic Carpet" Helps Growth of Plants Five Hundred Percent — Airplanes Used by Reindeer "Cowboys" on Alaskan Ranges — Eclipse Scheduled to the Minute Years in Advance

upon one another to produce human life, "the greatest marvel of the universe." The intricate processes which produce the energy of intelligent thought and action, Doctor Carrel believes, lead inevitably to old age, decay and death.

Still, the hope of eternal youth persists. Modern Ponce de Leons, if they have not found the elixir of life, have at least aided many years to man's allotted time.

A recent gift of one million dollars to the University of Chicago by Albert D. Lasker is to be devoted to the lengthening of life by preventing and curing the degenerative diseases of old age.

In 300 years the average span of life has increased from thirty to sixty years. Dr. Eugene Lyman Fisk, director of the Life Extension Institute, predicts it will yet be increased to 100 years. "There is no known limit," he said, "to what man's intelligence may effect in the way of life lengthening."

Picked Fruit Keeps on Living

FRESH picked fruits are living things. They breathe and give off heat, much as human bodies do. Half a dozen barrels of fresh apples will produce as much heat in the course of a day as fifty pounds of coal burned in a stove!

Those surprising facts were revealed to the London Physical Society recently by

Dr. Ezer Griffiths, who has been studying methods of shipping perishable fruits over long distances.

Apples and other fruits continue to live after they have been picked, he said. They begin to decay only when the living cells within them cease to breathe. Experiments determining just how much breathing is necessary to keep the fruit fresh have been applied in designing new methods of ventilating the holds of fruit ships.

Expert Vindicates Coffee

PROF. RALPH H. CHENEY, of the Biology Department of New York University, has completed a study of coffee and its effects on animals and men, and has reached this verdict:

Far from being harmful, the cup of coffee, if not abused, is actually beneficial to most people. Indeed, its reasonable use is a "great blessing" to more than ninety percent of normal individuals. The amounts of the drug caffeine that it contains are not enough to cause severe injury.

He lists the benefits of coffee as follows:

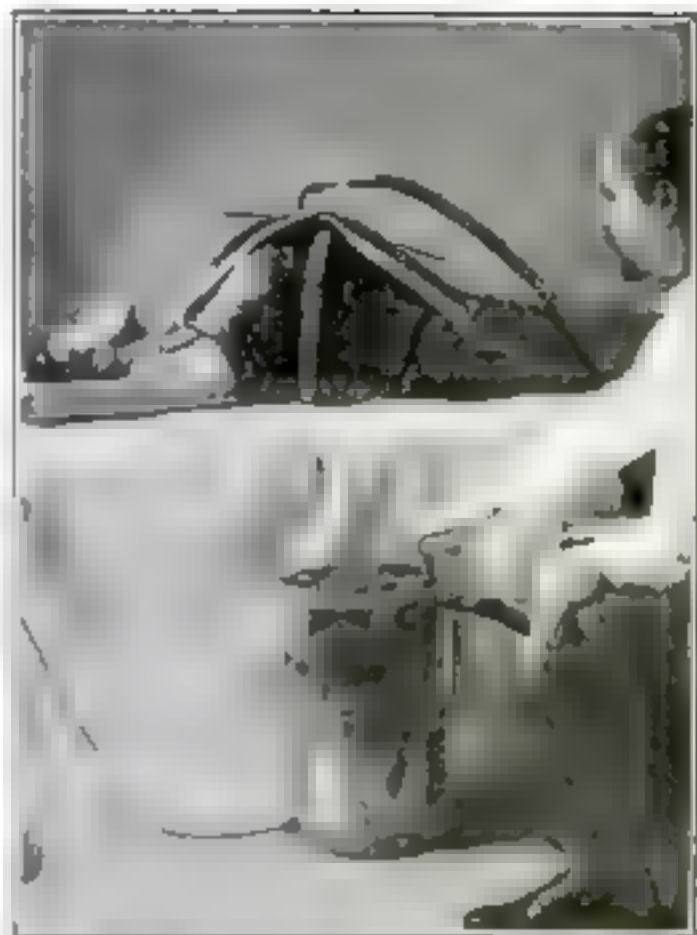
Psychologically, it gives a sense of well-being and good cheer.

It offers temporary relief from hunger and fatigue.

It relieves light headaches.

It serves as a mild stimulant of the heart, brain and muscles, "thereby accomplishing greater power and coordination in mental and physical endeavors."

Another beverage, Professor Cheney concludes, "produces equal stimulation without deleterious after effects."



This strange new device to revive persons apparently drowned or asphyxiated is a sort of leather jacket that fits over the chest. Then a pump produces a vacuum that moves the diaphragm, which we normally use in breathing. The power is suited to the patient by the regulating lever in the operator's hand. Dr. Kiermenger of Vienna, is the inventor of the device, which rivals the pulmonary.

Eclipse Scheduled to Minute

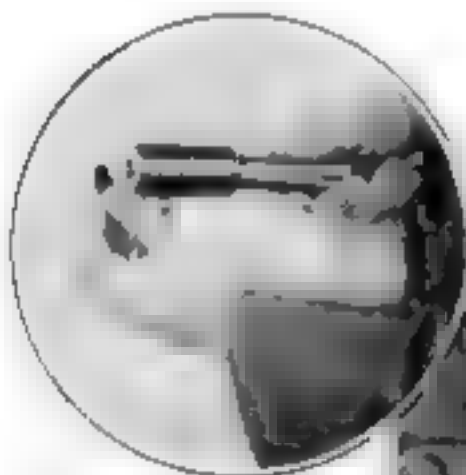
MODERN astronomers with their telescopes survey the heavens with uncanny accuracy.

The exact path of the next total eclipse of the sun to be seen in the United States has just been charted by Dr. L. J. Comrie, of the British Nautical Almanac office. The eclipse will occur at 3:30 p. m. on August 31, 1932, and will be seen in Maine, Vermont, New Hampshire, Quebec and as far south as Salem, Mass. The central line runs from Pierreville, Quebec, to Biddeford, Maine, passing over the White Mountains. Montreal will be on the edge of the path, as was New York City during the last eclipse in 1925.

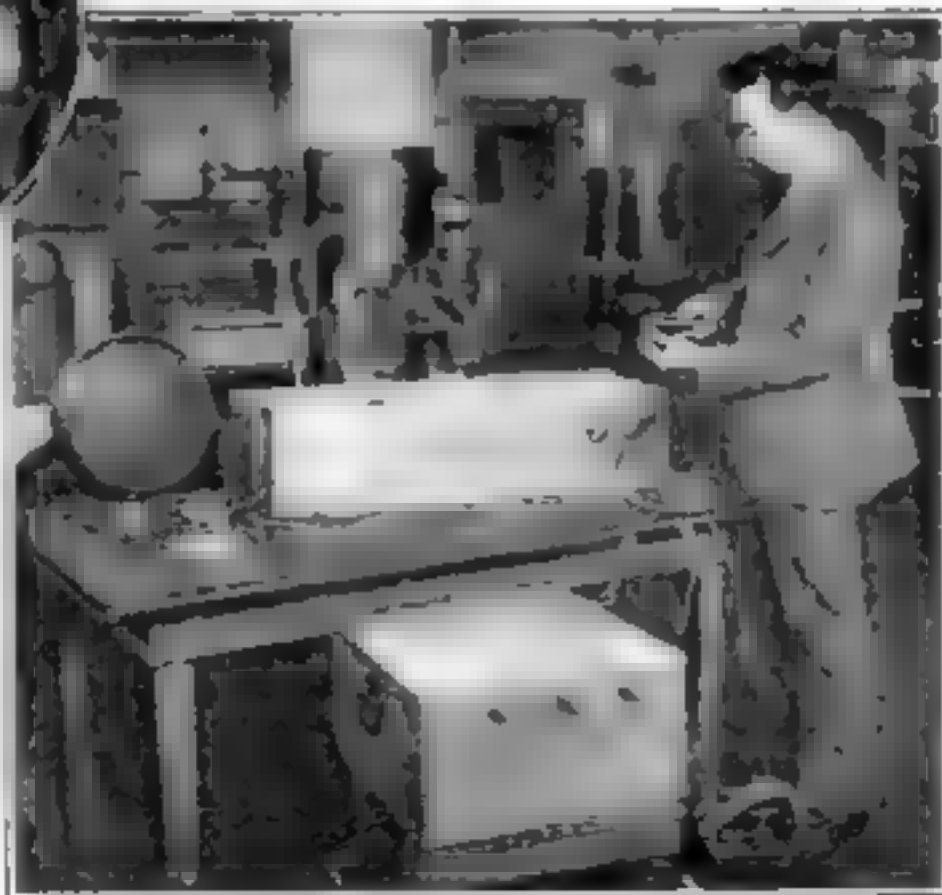
After forty years of labor, the Oxford and Greenwich observatories in England have completed a map of the heavens, including 13,000,000 stars, every one of which has been photographed. Only 6000 of them are visible to the naked eye. Nineteen observatories in various parts of the world have cooperated in the enormous task. Stars up to the fourteenth magnitude are included. To map fainter stars will require thirty years more work. The new charts will prove invaluable to future astronomers in studying the movements of stars.

Electric Power by Balloon

AN ITALIAN inventor's novel solution to the farmer's problem of supplying electric power to drive plows or tractors by electricity is to feed the current over a cable of aluminum wire supported in the air by balloons. Storage battery driven apparatus has been found too expensive to install in experiments conducted abroad.



A tiny platinum needle that radiates the emanations of uranium. The emanations of uranium are emitted in small quantities and counts them has been developed at last from the emanations of uranium devised by Hans Geiger, German physicist, by Dr. C. W. Hewlett of the General Electric Company. To study a patient's blood in Boston City Hospital a radioactive substance is injected and the instrument placed against the body records the emanations. The pictures show the emanations of uranium.



How Do they *Know* about Atoms?

They Don't! At Least, There Is No Direct Proof, But Here You Can Find the Answer to Your Question

By GEORGE LEE DOWD, JR.



The portable X-ray apparatus with which Laue, Swiss physicist, made the first photos ever taken of atoms. They showed five atoms in a diamond.

BEFORE you lie a pound of copper—a reddish, shining metal lump. To your eye, it seems solid enough. If anyone told you that pound of copper was for the most part empty space, that it was inhabited only by countless swarms of tiny buzzing particles of matter that gave it its shape and weight, you could hardly be blamed for incredulity. Nevertheless it is true. Forty-three million million million million separate copper atoms, declares Dr. Paul D. Foote, of the U. S. Bureau of Standards, go to make up that single pound lump!

How does he dare to make such a statement? What tells him he is right? No one has ever seen an atom. The most powerful microscopes in the world cannot even reveal molecules, which are groups of atoms. After all, just how do experts know definitely the concrete things they tell us about atoms and molecules they have never seen?

The answer is that they don't—there is no direct proof. The scientific evidence as to these innermost secrets of matter is entirely circumstantial. The best explanations of the atom's conduct are only theories—but theories so thoroughly tested and demonstrated that now there can be little doubt of their truth.

CHEMISTS say they can measure the heaviness of one atom compared with another far more accurately than a grocer weighs his merchandise. Lightest of all is the hydrogen atom, which weighs just twenty-five thousandths of a grain divided by the figure one with twenty-one ciphers after it.

Sir Oliver Lodge, eminent English physicist, is responsible for this exact statement, which means simply that the hydrogen atom is a million million million times as light as the tiniest grain of lycopodium powder, perhaps the least heavy thing you can imagine.

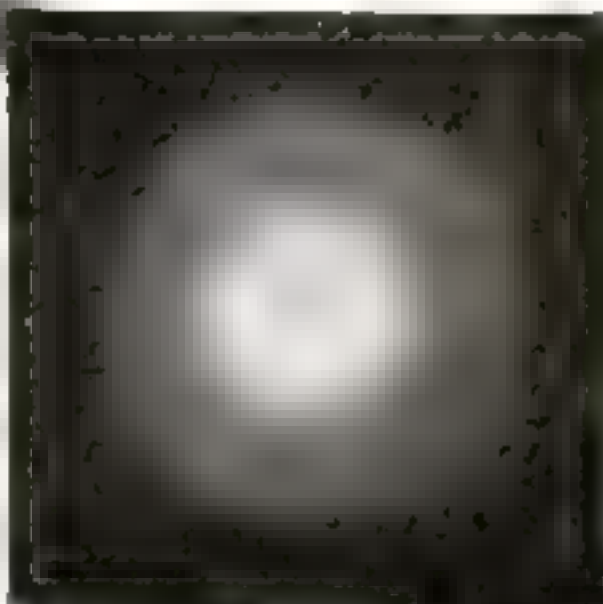
Sir Ernest Rutherford, the world's greatest authority on the atom, calculates that a cubic inch of helium gas contains precisely seventy-seven billion billion atoms. As for molecules, the next thing larger than atoms, as final an authority as Prof. R. A. Millikan, of Pasadena, Calif., says, "We can

deduce, brilliantly, his belief, but it gave the first photographs ever taken of atoms themselves! With amazing fidelity an X-ray picture of a diamond showed a carbon atom at the center of a four-sided figure and four other carbon atoms at the corners, just as chemists had already conceived it! With such X-ray patterns to work from, it was easy to construct models of molecules that could not be far from the truth.

WHAT a sight would await us if, with a microscope, we could peer into the unseen realms of the densest solid such as steel, for example! We should discover that it is not a solid at all, but made up of countless minute electric charges grouping themselves like suns and planets into infinitesimal solar systems. These solar systems are the atoms, their planets are electrons. They are forever moving in hit-or-miss fashion, a space between each, jostling, colliding, rebounding.

We know this because if we suspend minute particles of fine solid substance in liquid, under a powerful microscope, we see the particles bounding and colliding. We can observe too, that every now and then the commotion causes a few of the tiny solar systems to fly off from the rest! Press gold between two blocks of lead, for example, and you find particles of gold which, shot off, have penetrated far into the lead itself.

But how can you count and measure molecules and atoms? By another application of the X-ray it is possible to measure, with the astounding precision of one one-hundredth of one percent, the distance between two layers of atoms in a crystal! Armed with these measurements, it is an easy step to the actual size of the molecule and of the atom itself, and the number of them that can inhabit any given space. Actually the diameter of a molecule, a group of atoms, turns out to be less than one one-hundred-and-twenty-five-millionth of an inch—far beyond the reach of the most powerful microscope known. To calculate the size of the atoms themselves, the chemist must help. By the character of the reactions in his test tubes, he can tell how many atoms any molecule contains. (Continued on page 126)



A Bell Telephone Laboratories X-ray photograph of the inside of a molecule of a salt known as magnesium perchlorate. From this experts construct diagram of the molecule's structure.

Right: The salt crystal slightly turned gave this picture. The crystal's position, the type of X rays used and the spacing of the atoms composing the molecule determine the curious pattern.

now count the exact number in any given volume or weight of a uniform substance with even more certainty than we can count the population of a city or state." For instance, he places the number in a cubic centimeter of air (about the size of a large pea) at "exactly 27.65 billions of billions."

How do they know? While Rutherford and Niels Bohr, the Danish wizard, were already delving into the innermost secrets of the atoms they felt sure were there, it remained for Laue, a Swiss physicist, to give the final, conclusive proof that atoms really do exist, grouped into molecules. He took small crystals and turned X-rays on them, seeking to prove that their lattice-like atomic structure would deflect the rays in a definite pattern.

He succeeded beyond his warmest hopes. Not only did the experiment ver-

Hurtling through Space In a Parachute

By L. G. POPE

K. Kenyon of the Navy, photographed from a plane as his parachute was opening.

Newest Tests Prove Jumper Can Somersault Thousands of Feet Safely; Anyone Can Learn How

THREE quarters of a mile straight down, hurtling head over heels through empty space! Then a jerk of a cord, and a great silk envelope opening overhead to check the dizzying plunge. That was the experience, the other day, of John Trantum, crack parachute jumper, when he stepped off the wing of an airplane circling less than a mile above Los Angeles.

How far can a man fall before unconsciousness seizes him and he is unable to open his parachute? Trantum was taking his life in his hands to find out. Government officials want to know, and were to time his nerve stunt.

Swish! Snap! Down he plunged, deliberately keeping his hands off the rip cord that would open his life-saving "umbrella." Imagine, if you can, his sensations! A second passes, like a century, and he has dropped about thirty feet. Another, and another—now he is catapulting through the air at a mile-a-minute clip. There is the earth looming up to him, lurching, whirling crazily. Not a second to spare—pull the rip cord! He does, and ends his dare-devil plunge. His stop watch has stuck. The official timers have failed to appear. He swoops to earth to find that the fall he estimates at 4000 feet is not a record after all—that the world's record of a 4200-foot drop before opening the parachute still stands!

THOUGH you yourself may shudder at the thought of parachute jumping as a hobby, Trantum is far from being the only man to whom life is a succession of falls. Leaping from airplanes far up in the clouds is hardly a stunt any more for

James T. Clark, chief machinist's mate and parachute tester of the U. S. Navy. "Jummy" Clark is a stocky, hardened man of the air. His face is that of a fearless adventurer—betraying in every feature courage and determination.

Taking-off from a plane a couple of

thousand feet up, somersaulting down at a hundred to two hundred feet a second, and suddenly being jerked back when the parachute opens to the air—all this is simple after you learn, he solemnly declares. And it doesn't take long to learn. One time is sufficient, he says.

Does it give you shivers? It didn't give him any shivers even the first time, says Clark. His trouble was not in the air, but on the ground before he went up—making up his mind that he would jump when the time came.

"I'D RATHER get out of an airplane with a parachute than leap into the ocean from a ship with a life preserver," he says. "All things considered, the parachute is probably safer.

"I have fallen a thousand feet or more before opening the parachute. You might fall five or ten thousand feet with the parachute folded on your back without being hurt, provided the start was high enough."

The common belief that when anyone falls a great distance the rush of air takes his breath away, bites exposed parts of his body and sometimes causes death through suffocation or shock is all imagination, according to this daring adventurer of the sky. The only thing of the kind that he notices is the frightful swish of air past him. It is like being in a tornado traveling four or five miles a minute.

It is a strange picture of the world, according to Clark, that the somersaulting parachutist sees, now with his eyes toward the sky above, now catching a hazy, momentary glimpse of the ground. Color



Jimmy Clark, Navy's parachute tester, with equipment harnessed to him, touching rip cord ring, which he says even a panicky jumper always finds

almost vanishes. All is a blur of grey. The speed is too great for things to register on the eyes.

To show the rest of the world what the jumper sees, Clark and a naval officer, Lieut. G. T. Owen, of the Anacostia Air Station, near Washington, not long ago tried to take a motion picture. An automatically operated camera capable of sixteen pictures a second was strapped to Jimmy's breast. Lieut. Owen flew his plane up 2000 feet and Jimmy jumped.

The fall was far too fast; the camera registered only a flickering blank until the parachute opened; then a fearful hodgepodge of earth, sky, space and water.

With the development of aviation, the parachute has been so improved that it is now comparatively safe. Clark, in all his exploits, has never suffered a scratch.

As long ago as 1821 Lieut. Arthur G. Hamilton safely dropped 24,400 feet from a plane at the Army's school for parachute jumpers at Chanute Field, Hantoul, Ill. Sergt. Enoch Chambers plunged 30,000 feet. Miss Phoebe Fairgrove descended nearly three miles—13,000 feet, to be exact—without harm at Curtiss Field in 1921.

Several pilots have been killed in similar leaps, only because their parachute equipment was fouled by some part of the plane as they were taking off.

SEVERAL types of parachutes have been devised. One developed by the Army Air Service at McCook Field, Ohio, in 1919 is declared never to have failed through any deficiency of its own. A very small pilot parachute is attached to the top of the familiar huge one. A rip cord, fastened to the small bag, is held by the jumper. When the rip cord is pulled, rubber springs throw open the miniature parachute, and this in turn draws out the main bag, which then inflates, leaving the miniature one to sag emptily above for want of air.

The Army and Navy require all flyers to carry parachute equipment. In some cases the aviator is supplied with two complete sets of parachutes, lest one set fails.

With the parachutes now used is included a set of harness. It fastens to the body so as to distribute the shock the jumper gets when the parachute inflates, which would be terrific if centered on one part of his body. Thus, he experiences a sensation like falling into an enormous feather bed when he pulls the ring at the end of the rip cord, which hangs handy on his breast.

The greatest danger, Clark thinks, is that the jumper will jerk the ring too soon. That may cause the bag to open before it is entirely clear, and



Before Navy men risk their lives with parachutes the devices are tested with dummies such as the one shown. The pilot of the plane is Jimmy Clark.

he caught on some part of the plane. In that case you land in eternity.

Of course, experience is a great asset to anyone who proposes to leap half a mile or so through the air. "Yes," you say, "but how is a man going to get it?" Well, the novice usually starts with what is known as the "pull-off." Instead of deliberately jumping from the plane, he clings to a wing strut and releases his bundle of silk. It inflates and yanks him out into emptiness.

ONCE in the air, the jumper may to some extent so guide his course by means of "side-slipping," after the manner of aviators who sometimes "side-slip" their planes. It consists in throwing the weight of your body from side to side, so that the parachute takes in more air on one part than in another. However, the jumper is in danger of making a pendulum of himself—of swinging back and forth until he lands. When this happens, he is a lucky man if he comes down



Expert folding is required for parachutes so that they will open with maximum speed and with no "hitches." Seconds lost may mean death.

without a wallop and a broken bone or two.

The safest landing is that in which the parachutist comes down feet foremost, with body relaxed and slightly inclined backward. A posture like this is a safeguard against falling and consequent dragging along the ground. If some mishap occurs, resulting in dragging, the jumper can bring the parachute to a comparatively quick stop by pulling the lines on the side next to the ground, thereby causing the bag to flatten out and deflate.

ORDINARILY, despite the best of precautions, the leaper gets something of a shock when he lands, but under favorable conditions the usual landing is like jumping off a wall six to ten feet high.

A parachute might be thought to be a comparatively inexpensive stretch of cloth, but a complete outfit actually costs in the neighborhood of \$300, and formerly cost more than twice that much. For this reason, in some measure, the Navy Air Service, with its limited appropriations, is inadequately equipped. During the fiscal year 1927 only 213 were purchased, and 1000 more are needed, according to Rear Admiral Moffett, Chief of the Navy Bureau of Aeronautics.

Heretofore the high cost of parachutes has been due to the use of an expensive Japanese silk. Now an American weave of imported yarns has been perfected by the Bureau of Aeronautics and the Silk Association of America. It is declared to be even superior to the Japanese in some respects.

Parachutes call for exceedingly strong fabrics and intricate seaming. If one should be caught in a high wind, it might rip and deflate, hence they are interlined with stout cords and put together with so many seams that if a rip does occur, it has little chance of extending far.

But for the novice it is always difficult and sometimes impossible to remember the stoutness of the parachute's construction. Nothing that Jimmy Clark or any one else can say about silk umbrellas being safer than life preservers can overcome the novice's instinctive trepidation. Slow motion pictures of "pull-offs" reveal the shakiness the beginners invariably experience. They hold on for dear life to the very last, even though knowing that the tremendous force of the air in the parachutes is certain eventually to drag them off into space. Yet they virtually all agree that, as the veteran says, one learns very quickly. Some say the first time is the hardest. Others say the first time is the only one that is hard at all. After that they find it pure fun.

Strange Radio Devices Locate Buried Treasure



By ALBERT HENRY KINGERLY

CAN radio waves and dynamite reveal buried treasures of gold, oil and copper? "Yes," is the startling answer of mining experts in various parts of the world. A prominent Swedish geophysicist, armed with a radio device, has discovered, buried beneath a swamp, what may prove to be the richest arsenic deposit in the world. Huge oil pools in Texas have been found with pistol shots and earphones, dynamite and seismographs. From Panama come reports of an investigator who claims to have unearthed buried pirate hoards through a radio device of his own design.

THE schools of mines at the Universities of Colorado and Utah are already training students in the new electrical prospecting. The U. S. Bureau of Mines is to check the possibilities of each of the recently discovered ways of detecting invisible ore on known ore beds in the Carbon hills of Colorado. Dr. Max Mason, geophysicist and president of the University of Chicago, has already tested the accuracy of ore-locating devices over four well-known ore bodies in as many different mineral regions. Each time, he reports, the modern detector agreed completely with facts previously discovered only by actual digging.

In "radio prospecting" a miniature broadcasting station is set up and radio waves penetrate the earth.

Near the transmitting apparatus stands a man with a

pair of earphones. He swings two loop antennas about until there is a murmur in the phones. Carefully he notes down the exact tilt and swing of the loops. Then he repeats his observations again and again at different locations, until the radio signals are heard no more. Thus a subterranean ore body can be charted without a single test drilling.

THOSE using the new methods disdain any hint of magic in their devices, which simply are the application of sound physical laws. They point out that a certain percentage of failures must be expected, depending on the intelligence, knowledge, and experience of the explorers. Striking successes are possible.

When Dr. Axel Gavelin, head of the Swedish Geological Survey, tried out an electric ore-locating device recently

When the radio receiving apparatus (right) is set up a little distance from transmitter, left, murmur in phones is said to indicate sulphide ore is near below. Radio waves from this device, says inventor, will locate gold

invented by two mining engineers, he succeeded in locating thirty-four large ore bodies containing gold, silver, copper, sulphur and arsenic—the last of phenomenal richness. All the deposits were covered by swamps, lakes, or glacial drift and might never have been found by the usual methods of prospecting.

Searching for buried treasure is the remarkable application that Lieut. George Williams, of Ancon, Canal Zone, says he has made of radio prospecting. Near Panama City and in Porto Bello, Panama, he is seeking hidden hoards among

ancient ruins with the aid of a radio apparatus that he devised, under a four-year concession from the government. One of his reported discoveries is a hoard of gold found eight feet below the ground on a military officer's estate, besides other quantities of silver on the same land. Lieut. Williams asserts that he has never dug, after locating a supposed treasure with his radio, without finding something of value.

NATURAL treasure, in the form of vast oil pools beneath the earth, is being sought by some of our large oil companies with thirty-pound charges of dynamite as tools. When the explosions shake the earth and send tremors speeding through it, a number of seismographs or earthquake recorders spaced in a ten-mile circle about the blast record the miniature earth. (Continued on page 158)



Sending apparatus Lieut. George Williams says locates treasure in Panama. Left to right: Aerial, transmitter generator. With receiver Williams "listens" for treasure



Into the throng of Swiss villagers rushed Mabel, crying a warning of approaching flood.

The Movie Maker

A Thrilling Novel of Screen Magic

By S. W. NEWMAYER—Illustrated by ERNEST FUHR

Few fields of invention offer such fascinating opportunities as the motion picture. Only the other day C. Francis Jenkins, noted inventor of Washington, D. C., perfected an amazing camera through which movie film can be fed at a speed of three miles a minute! Its purpose is to reveal the movements of high speed ma-

chinery. "The Movie Maker" tells the story of equally remarkable inventions. While the characters and plot of this delightful novel are woven of fancy, they move in the substantial background of actual discovery and ingenuity which have made the motion picture one of the wonders of our age.—The Editor.

AMBITION to produce a big feature picture. Don Kennedy, young comedy director of Popular Players' West Coast Studio, and Judy Burke, his script girl, joined in a gamble for high stakes. Don's chief asset was an invention for superimposing action photographed in the studio upon scenic backgrounds filmed abroad—an invention that promised great economies. Judy offered her talent as a scenario writer. When Popular Players suspended production Don obtained the use of the "lot" rent free for four months to produce the feature—provided he should assume the contract of Margaret Moreland, a high-salaried but fading screen star. In the wild venture they were joined by Judy's brother, Jerry, a stunt flyer, and Professor Mahlenburg, an old photographer. Together they attended the first performance of Margaret Moreland's latest picture. It was a failure. Fleeing disgrace, Margaret attempted to kill herself, but was saved by Jerry. She turned out to be the estranged daughter of the old professor. Margaret joined the new venture, offering her services free, and investing also a costly ring from her finger. Don commissioned "Boss" Biddle, an expert camera man, to photograph background scenes in Europe and Asia while the others began filming the action on the lot. At the end of a month their money

was almost gone. Failure stared them in the face when Judy evolved a scheme of obtaining the backing of Susan Rogers, a wealthy newspaper owner, in return for giving his daughter, Mabel, a leading part in the big picture. They planned to meet the millionaire and his daughter at Everglade Grove. Now read on:

IT WAS nearly midnight at Everglade Grove. The orchestra crashed into the final pulsing rhythm of a tango, the whirling couples on the floor catching the rising lilt in quickened steps.

Don, seated at a table with Judy and her friends, saw Jerry's dark head bent over coils of gleaming fairness, as he dexterously swung Margaret around the floor. Then his eyes returned to a study of the girl at his left. Mabel Rogers was seventeen—large, placid, and remarkable for nothing save an economy of words, a capacity for food, and a somewhat rough resemblance to the Statue of Liberty. Beside her, small and sparkling in a gay yellow

gown. Judy looked like a bright-eyed canary.

"Then fifty thousand will cover the changes necessary to give my daughter a real chance in the picture?"

DON turned his attention to the man across the table, and hesitated. Silas Rogers' voice was as abrupt as his manner, a manner which indicated that he could set the world in motion or stop it by pressing a private button. As he waited impatiently for Don's reply, a stray beam from a wall bracket lamp threw a highlight on the nub of his bulbous nose, shot a gleam on the eyeglasses set at a belligerent angle in front of his deep-set blue eyes, and polished his forehead, doming baldly back into a fringe of straw-colored hair. Not a very peaceful looking backer, reflected Don.

At this point in his deliberations, Don felt a smart tap on his ankle, but before he could accept Mr. Rogers' offer, that gentleman had begun to speak in a more conciliatory tone. Accustomed to walking roughshod over the citizens of his own little world, he had misinterpreted Don's silence as opposition—and Silas Rogers was accustomed to getting what he wanted at any price.

"Perhaps we'd better raise that to a hundred thousand," he amended, and a genial smile brought his undershot jaw almost into line with the stiff pale brush of his mustache. "Don't want you to skimp on the part for my little girl. I'm going to give her lots of publicity and the picture will have to live up to it."

"Oh, Mabel's part will be wonderful!" gasped Judy, and Don felt a more violent tap on his ankle. "She's going to be chief character in a long sequence—a flood scene in an Alpine valley."

"That's settled then." Receiving a nod of confirmation from Don, Mr. Rogers put his hand into his pocket and drew out check book and fountain pen. Then, with pen poised, he hesitated, drumming on the table with the spatulate fingers of his left hand. Don saw eagerness fade into anxiety in Judy's eyes and he himself felt a twinge of apprehension. In any game, he knew, the man with the money always held the high cards. What trumps would the successful bidder declare?

"Suppose," remarked Mr. Rogers contemplatively, "suppose we draw up a little agreement here—a ninety-day note at eight percent, secured by fifty-one percent of the stock in the company?"

"Does that mean," faltered Judy, "that if we can't pay your note January first we must forfeit half the ownership of our picture?"

"Fifty-one percent, my dear," corrected Mr. Rogers with a fatherly smile.

JUDY looked down at the tablecloth without a word and Don, gallantly but unwisely, hastened to reassure her.

"The picture will be finished by January first," he declared shortly, "but we must have an additional month in which to market it. Make it payable February first and I'll sign."

Mr. Rogers fingered his fountain pen and met Don's eyes in an oblique glance. He seemed to be considering the matter from a hidden angle.

"I'll jot down the terms on this," he said, turning a check blank side up. "We can both sign it and tomorrow in my office draw up a formal agreement with the same conditions."

The transaction was concluded almost in silence, and Don pocketed the check—not for the hundred thousand but for a



A spurt of flame shot up through the skylight. Judy screamed in dismay as Don released his hold and swung to the ladder that firemen on the opposite roof top had pushed across to him over the gap.

quarter of that amount, for the agreement reposing in Mr. Rogers' pocket stipulated the payment of the remaining sum in two installments: fifty thousand, November first, if Mr. Rogers was at that time satisfied with the progress of the picture, and the final amount December first if he again approved.

"And now," asked the millionaire newspaper proprietor briskly, "when does Mabel begin? I'll run a little preliminary publicity."

"Can you come tomorrow, Miss Rogers?" Don asked the object of the financial transaction.

MR. ROGERS' "little girl" looked up from the third chocolate éclair she was consuming and nodded. For the moment she was unable to speak. Judy, after one glance, turned quickly toward Mabel's father.

"Mabel will have to reduce!" she warned him. "She must stop eating so much."

"I'll see that she does," agreed Mr. Rogers. "Mabel, I've just invested a hundred thousand in you and I expect results!"

"Yes, Papa," replied his daughter dutifully; but a peculiar expression came into the large china blue eyes set far apart beneath her tranquil forehead. She looked up at the waiter hovering near. "I think I'd like another chocolate éclair," she murmured.

Her remark went unnoticed by all except Don, for at that moment Jerry and Margaret rejoined them. When the music started again, Mr. Rogers claimed Margaret. Jerry asked Mabel if she cared to dance, but she pleasantly refused, her eyes on the approaching waiter. Thoughtful and somewhat subdued, Judy took her place. The Professor had not come with them that evening, so Don was left alone with Mabel and her chocolate éclair—left alone to watch this new member of his cast and to

ponder. On his ability to mold Mabel into screen material depended the rest of the promised capital, and well he knew that a multitude of whims might be covered by that most important clause in the agreement—if *Mr. Rogers is satisfied with the progress of the picture.*

THE working title of the picture was "The Crusader," and now that Judy had cheerfully written in a part that made Mabel Rogers the second woman lead, she decided that her own diminished role as the Saxon lady's maid should be lightened with a little comic relief. Accordingly, after a discussion with Don, she wrote in a bit showing the maid seated in front of a dying fire in the big banquet hall of the castle. At first asleep, she is awakened by voices on the stairs and overhears the villain plotting a dire deed. At the same time, on a huge settee opposite, the hero is lying asleep in the flickering shadows, partly concealed by his long cloak. He is not aroused, and the maid dare not move without being discovered by the villain. Petrified by fear, yet anxious to warn the sleeper, she sits there listening, the expression of her face alone indicating her alarm.

In the effort to watch both the snoring hero at the left and the villain half hidden on the stairs at the right, Judy planned that the maid's eyes should roll wildly from one to the other until they finally solved the difficulty by moving simultaneously in opposite directions. To accomplish this double exposure trick more than ordinary care was required for the two halves of Judy's face had to be photographed separately.

"I don't think it's feasible," objected Don when she first suggested the idea to him. "The slightest movement of your head would throw the whole thing out of kilter."

"But I'm supposed to be too scared to move anything except my eyes," Judy pointed out. "When I wake up, my head is resting against the side of the fireplace and I won't budge it an inch."

"EVEN a thirty-second of an inch would be enough to ruin the trick," replied Don. "You know we'd have to screw the camera and your chair to the floor to take the double exposure, but we can't nail your head to the fireplace. And in spite of yourself—in fact, just because you'll be doing your level best to hold your head rigid—it will waver just a bit."

Judy looked disappointed.

"I know it's only a trifle," she admitted, "but we need bits like this to liven the picture, now that Mabel's going to lumber through it."

Don chuckled, then considered the matter again.

"I believe I know a way," he remarked at last. "It'll be a tedious job for you but we can swing it. There's an old photographic headrest at home. We can turn the trick with that."

So when the close-up was made, an old-fashioned standard concealed behind Judy gripped her head in iron arms, its clamps hidden by a white mob cap frilled around her face. Several times they tried the exposure with other members of the cast looking on amused, but although the two sides matched evenly, there was always a slight deviation in the doubly exposed expression of the face that made the picture look unnatural. That, of course, stamped the close-up as a trick picture when it was thrown on the screen, and the startling effect of the eyes rolling in opposite directions was lost.

"That won't do," declared Don, studying it in the projection room. "A trick is no good at all if it shows as a trick. We'll try again tomorrow."

Before the rest of the cast arrived next morning, Don screened off from the main portion of the set the corner of the fireplace,

leaving just enough space to operate the camera. Then he clamped Judy into the standard again and with Tim at the camera, slowly timed the action aloud.

"Eyes down left—one—two—three," he counted rhythmically. "Eyes up left—four—five—six. Cut."

Inclosed by the blank screens and with not even a passing stagehand to distract her attention, Judy fell into time with the slightly hypnotic rhythm of the count, her face retaining an expression of alarm throughout.

With this bit of action successfully photographed, Don shot the remaining close-ups and foregrounds scheduled for the banquet hall scene. Then followed the medium and long shots, for which the Professor and his scenic artists had made elaborate preparations.

All of the action in this setting was planned to center near or directly beyond the fireplace and lower portion of the great staircase leading up from the banquet hall. Therefore this part of the set had been built on a natural scale proportionate with the size of the actors, but it rose in no place to a height greater than eight feet. The chimney of the wide fireplace stopped abruptly in mid-air, the stairs took a turn behind a wall that reached just two feet above Jerry's head. The settees

on either side of the fire were full-sized, but the baronial banquet table, set even with the fireplace and extending beyond the stairs, grew rapidly narrower at its farther end.

THEN the professor's artistry and technical skill stepped in to complete the setting by illusion. Four feet in front of the camera was set up a wood-framed glass screen on which had been painted the upper portion of the banquet hall. Now, seen through the camera lens, the rough stone chimney of the fireplace appeared to rise to a high beamed ceiling. On the wall that concealed the stairs, presumably rising behind it, hung a large tapestry depicting an allegorical scene. The hall was now approached through a huge Gothic arch in the foreground, and on the faked wall opposite the fireplace windows similarly arched opened toward a starry sky.

To complete the scene, Don had a back drop hung beyond the banquet table. The drop showed a dim series of arches

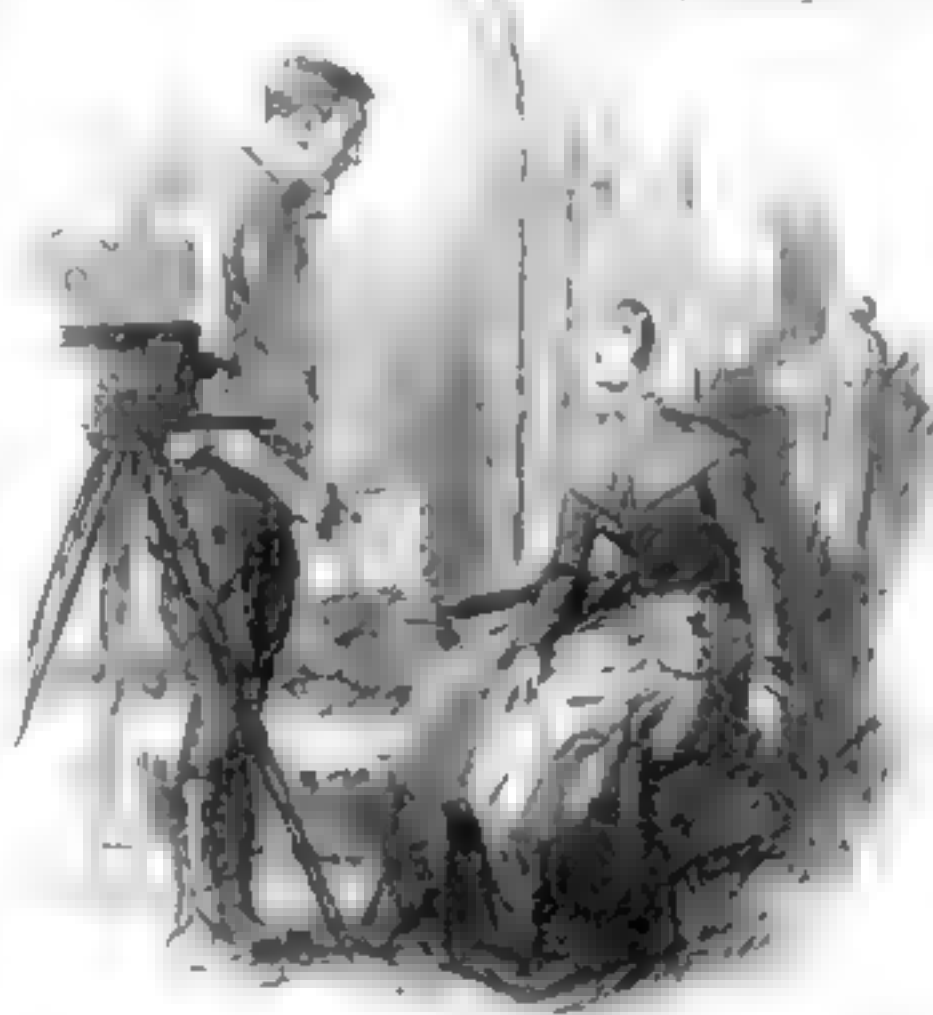
similar to the one on the glass screen in the foreground. Then, between the glass screen and the camera, the professor placed miniature models of the lower portions of the foreground arch, thus completing the one scene in properties and settings of three different size scales.

"Now the lamps, and we'll be ready to shoot," announced Don, raising his head from a satisfactory squint through the finder of the camera.

The property man and his assistant were standing by with five hanging lamps varying greatly in size; two large ancient ones of pierced brass and three imitations one half, one fourth, and one eighth the size of the originals. Climbing on ladders to the stage rafters above the set, a stage "grip" hung one of the large lamps halfway between the glass screen and the full-sized set. The second large lamp he hung above the center of the big set. The other three lamps followed in the order of their size, the tiny lamp immediately in front of the backdrop. All were arranged so that they seemed to swing on their chains from the beams of the banquet hall.

THE first rushes taken on this set were tremendously impressive. It seemed incredible that the extensive vista and the massive proportions of the scene were merely tricks that took advantage of eyes accustomed to judge all size and distance by comparison. Occasionally, however, the delicately balanced scheme was thrown

(Continued on page 144)



"I know it's only a trifle," Judy admitted, "but we need bits like this to liven the picture." Don considered the matter again.



Speed boat with inclined hull between pontoons as it is expected to look crossing the Atlantic Ocean in 60 hours

Plans to Cross Ocean in 60 Hours

Frenchman's Unsinkable Ocean-Glider Will Dash from France at Seventy Knots an Hour in a Few Weeks, Declares Inventor

By EDWIN KETCHUM

PARIS to New York in sixty hours! That is the mark set for himself by Adrien Remy, French inventor of a new type of speed boat, whose craft is shortly to undertake the trans-Atlantic passage. Already at a marine works on Saint-Ouen, near Paris, finishing touches are being applied to the full-size vessel that grew out of Remy's first plans. Early this April, if his project is carried through according to schedule, the craft will snort into New York harbor at a speed of seventy knots an hour!

Impervious to storms is the unique craft Remy has designed; tempests only slow it down a little, he says. The cabin, slung between two sixty-foot pontoons or floaters, is entirely inclosed so that the ship can drive its way through the highest of waves. In the pontoons themselves is said to be the secret of the craft's speed; when it is in motion, inclined bottom surfaces lift the ship part way out of the water, somewhat like a hydroplane, and thereby decrease the water's drag. From this principle comes the name *Océanoglisneur*, or ocean-glider, that Remy applies to his remarkable invention.

WITHIN the ship, the six men who operate it will see the outside world only through narrow portholes. The space inside is barely enough for their sleeping quarters, the engine room with its 650-horsepower gasoline engine, and a radio

room provided with sending and receiving apparatus. From the engine room, a shaft leads to the screw propeller of the marine type.

Originally it had been planned to use an air propeller, and to steer the rudderless craft by shifting the weight of three engines in the cabin. Some of the details were altered, however, before the boat stood ready for assembly on the banks of the Seine.

IN CASE the craft is successful in its first ocean voyage, another like it will immediately be built by its backers, to carry 200 passengers. It will also be able to serve for the quick transport of mail, and may be the forerunner of an Atlantic fleet of mail carriers. Such vessels, it is

also pointed out, would serve well as fast dispatch boats in the smaller seas of the world.

AMONG the men who will operate the new boat on its first ocean voyage are its designer, the foreman of the Saint-Ouen marine works, and two directors of the company which is financing it. An experienced captain and a wireless operator will complete the crew. They plan to follow the steamship lane, leaving Paris at dawn and arriving in New York two and a half days later.

Food for ten days will be carried so that if the strange new boat becomes disabled there will be no danger of hunger before some steamship renders aid. Whatever happens, the ship cannot sink, the builders declare.

The inventor of this strange craft regards it as a challenge to airplanes in the competition of swift and safe transportation, maintaining that the ocean glider develops the maximum speed that is possible without incurring danger. It is enough faster than steamships, he says, to offer an attractive advantage in saving of time; and, while it is slower than an airplane, it can survive the most violent storms, he says, which planes cannot do. Flying over land with fair conditions, or over small expanses of water, may be all right, he says; but distance sea flights are haz-

ardous. Many people would take passage on his type of ship, he says.

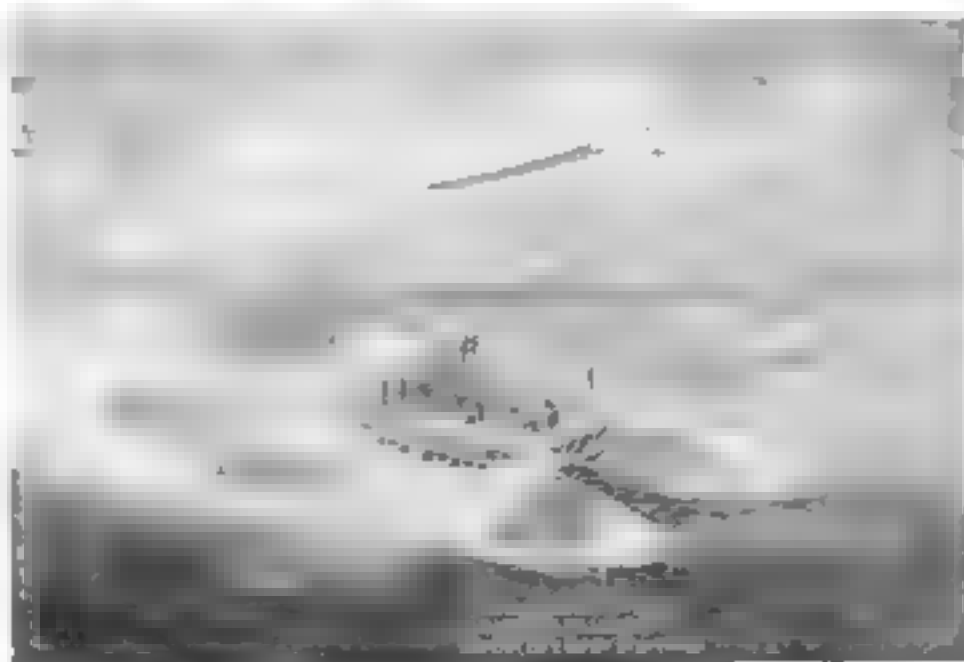


Diagram drawing showing construction of 650-horsepower ocean-glider in which Adrien Remy, French inventor, says he will soon cross ocean

Wonder Stories in the Making

Marvels Come Not Singly but in Scores as Two Thousand Scientific Leaders in Conference Tell of Discoveries

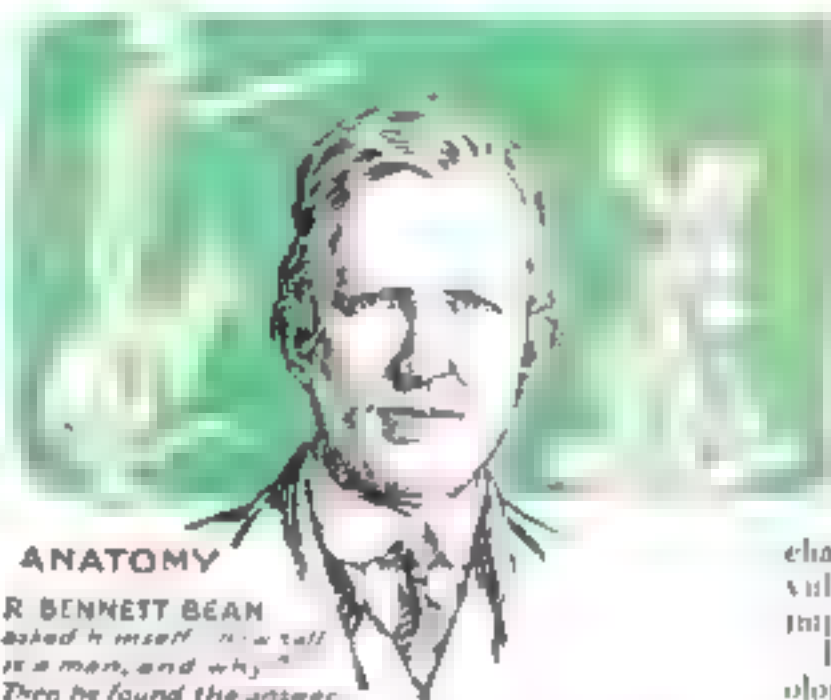
By FRANK PARKER STOCKBRIDGE

I USED to think of scientists as whiskered hermits or spectacled grouches, as most people do who don't know them. I have just spent a week with two thousand of them at Nashville, Tennessee, at the 84th annual meeting of the American Association for the Advancement of Science. They resembled nothing so much, in the aggregate, as a bunch of school teachers on a picnic. Which is precisely what they were, mostly; college professors spending their Christmas vacation in renewing acquaintances and exchanging reports of the research work they and their students had been doing. Most of them young; even the older ones acted young.

Evolution and genetics—heredity—were the main themes discussed. A fair half of all the scientific research going on in the world is in the effort to discover the laws governing the transmission of characters from one generation to the next, the reasons why animals and plants develop new species.

MORE insect men than specialists in any other one line. "Why so many entomologists?" I asked of Dr. L. O. Howard, the world's greatest "bug" on bugs, who looks like a rear admiral. Just retired after thirty years service as Chief Entomologist of the United States Government, he is the man who organized and led the war on the house fly which has cut the typhoid death rate to a minimum.

"Because there are more insects than any other form of life," he said. "We know of two million different insects,



ANATOMY

R. BENNETT BEAN
asked himself "How tall
is a man, and why?"
Then he found the answer.

most of which must be exterminated if man is to continue to live on earth."

THE pet insect of the students of heredity and evolution is a tiny fly with the poetic name of *Drosophila*—accent on the "soph." Everybody has seen these tiny midges, a tenth of an inch long, they hover around fruit stands in the summer, feeding mainly on decaying bananas. Because they are easily bred and fed, and particularly because they produce a new generation every nine days, they are handy subjects for laboratory experiments in heredity. It was his experiments with the fruit fly which won for Dr. H. J. Muller, professor of zoology in the University of Texas, the \$1,000 prize of the Association for the most notable paper read at the meeting. Young Dr. Muller, native New Yorker, Columbia graduate, looking like a storekeeper, has won international fame through his application of the X-ray to speed up the processes of evolution. I got him out of bed to tell him the awards committee had given him the prize. His first thought was to telegraph his wife, also on the faculty of Texas U. "I found that by exposing the fruit flies to X-rays, changes occurred in the cells which control

the transmission of characteristics to their offspring," he said. "I have experimented with 150 generations of flies, probably half a million individuals. Some breed young with white eyes instead of red, some have wing deformities of various kinds which are transmitted to offspring through several generations. What chemical change occurs and why are things to be found out; the thing which has been proved is that the X-ray does affect the parents in such a way that the course of heredity is changed." Some of the scientists at Nashville declared Dr. Muller's work to be as important as Darwin's.

Dr. Frank B. Hanson, professor of zoology at Washington University, St. Louis, might, from his appearance, be a bond salesman. He has been working for a year with Dr. Muller in his X-ray experiments in evolution, but his own pet sub-

ject for experiment is white rats. "I have about a thousand of a highly pedigreed strain on which I make my experiments," he said. "I have been trying to find out whether the excessive use of alcohol by one generation has any effect on the next, but so far as I can see it has none whatever. I make my parent rats into sots, more thoroughly alcoholized than human beings can get and live. They become completely demoralized, physical wrecks, but their young are always normal in every way. Thousands of experiments have given the same result."

OTHERS think plants are the thing for heredity experiments. Dr. Edward C. Jeffrey, professor of botany at Harvard, holds that fruit fly experiments are incon-

clusive. "I have come to the conclusion that the different species of animals and plants are the result of hybridization," he said. "Nature is constantly making new species by the crossing of different parent stocks. The ones best fitted to their environment survive. Darwin was right."



ANTHROPOLOGY

ALEŠ HRDLIČKA has traced the ancestry of the North American Indian to Western Europe.



ASTRONOMY

F. R. MOULTON: "The mind of man is growing better and better."

I got him out of bed to tell him the awards committee had given him the prize. His first thought was to telegraph his wife, also on the faculty of Texas U. "I found that by exposing the fruit flies to X-rays, changes occurred in the cells which control

There is too wide a gap, Dr. Clarence C. Little maintained, between insects and plants on one hand and man on the other. Biologists should devote more attention to the study of mammals. He recommended dogs and mice as subjects.

Dr. Little, president of the University of Michigan, is the youngest head of a great school and is an authority on genetics.

The American Mouse Club is already at work along the lines Dr. Little suggested. It is composed of fifteen biologists in different universities, each working on a different phase of mouse heredity. Prof. William H. Gates, of the University of Louisiana, its spokesman at Nashville, is trying to answer the historic question: "Why is a mouse when it spins?" "I am studying the Japanese waltzing mice," he said, "and have found that what makes them waltz is a defect in an ear canal which destroys their sense of horizontal equilibrium. If they don't keep spinning they fall down. This defect is hereditary, and I have produced the same defect in common mice by cross-breeding, these hybrids also transmitting it to their young."

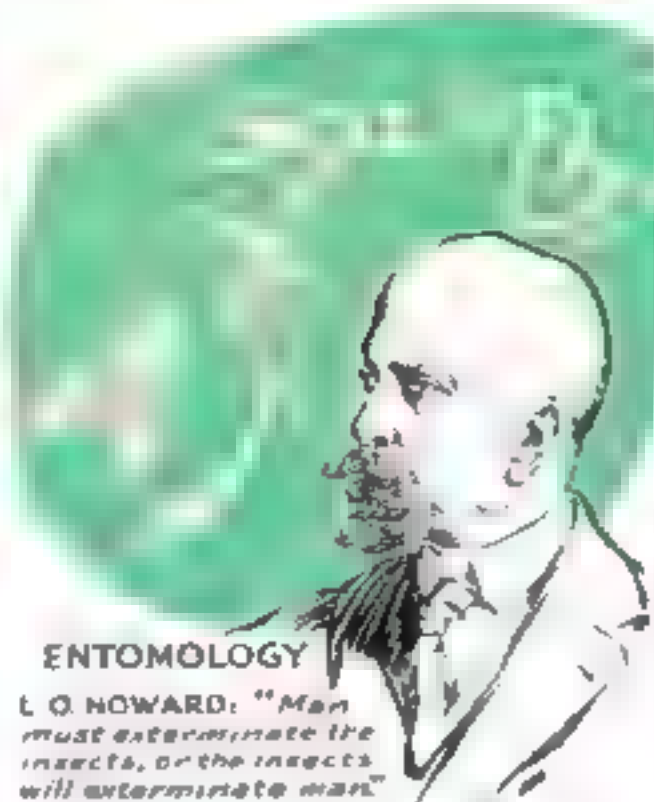


ZOOLOGY

H. J. MULLER has X-rayed half a million fruit flies to learn about man.

DR. R. BENNETT BEAN, professor of anatomy at the University of Virginia, asked himself the question: "How tall is a man, and why?" He has analyzed the measurements of 1022 groups of people on five continents. The average height of all is 164 centimeters, which figures out at almost exactly five feet five inches. The tallest group were Australians, six feet one; the shortest, African Negrillos, four feet three. The next shortest were Eskimos. "Nutrition fixes the stature of races," said Dr. Bean. "People living near the sea get too much iodine and tend to short stature; inland people get lime which makes for long bones. The difficulty in getting enough nourishment in the arctic and equatorial regions keeps those peoples short; the dwellers in the fertile temperate zones tend to grow taller because they have more and better food."

"THE continents are floating masses, the land is moving to the sea and another ice age or another continental flood may change all human civilization to



ENTOMOLOGY

L. O. HOWARD: "Man must exterminate the insects, or the insects will exterminate man."

something which no one now can foretell," said Dr. George H. Ashley, State Geologist of Pennsylvania. Dr. Ashley looks like a sheriff in a Western movie and believes geologists ought to get together on the age of the earth and other points on which they disagree before trying to instruct the public in the changes which are still taking place in the earth's structure.

PROF. W. C. CURTIS, head of the Department of Zoology at the University of Missouri and one of the experts for the defense at the famous evolution trial at Dayton, Tennessee, looks like a bank president, but knows so much about evolution that all the other scientists listen when he speaks. "The X-ray has provided science with a new tool whereby the exact nature of the physical and chemical changes inside the cell can be determined," he said. The ultra-violet, infra-red and radium rays are also helping to speed up experimental evolution, enabling the biologist to destroy visible substances within the nucleus without destroying the life of the cell. A group of biologists in Cincinnati found that by the application of the X-ray they could purify yeast by killing certain bacteria, and their revenue from this process maintains their experimental laboratory.

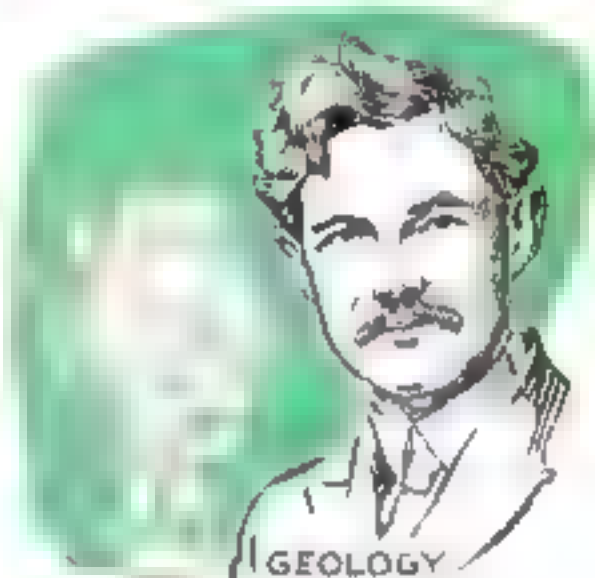


ACOUSTICS

MARK H. LIDDELL has photographed the human voice.

DR. ALEŠ HRDLIČKA, renowned anthropologist of the Smithsonian Institution, has the high cheekbones of the Czech, which his almost unpronounceable name declares him to be. The nearest one can come to his name in English would be "Alice Hrdlitchka." He has evidence, he said, that the North American Indians come from the same stock as the prehistoric Cro-Magnon man, whose remains, discovered in the Aurignacian caves of France, are believed to be those of the parent stock of the West Europeans. Physical characteristics and tribal habits, as indicated by the Cro-Magnon remains, are similar to those of many Indian tribes. This would dispose of the theory of Mongolian ancestry of the Indian.

THIRTY years of gazing at the stars have given Dr. F. R. Moulton, just retired as Professor of Astronomy at the University of Chicago, what may be



GEORGE H. ASHLEY: "Are we to have another ice age?"

called an unusually broad outlook on the universe. Gray-haired but still youthful, he is intensely optimistic about the future of humanity, believing that science will enable man to conquer his environment and remake the world. "Science is setting into action forces which will entirely revolutionize the economic, social and political relationships of human beings to one another," he said. The probable evolution of the human brain into a more efficient organ than it now is will come about, until in a million years or so all men will have greater reasoning powers, creative imagination and esthetic appreciation than anyone now has.

IT TOOK the ingenious mind of Dr. Mark H. Liddell, Professor of Philology—which means the study of words—at Purdue University, to utilize the newest scientific apparatus for the analysis of speech. By means of a new type of oscillograph, devised at the Bureau of Standards, which sends off a stream of electrons instead of a reflection from an oscillating mirror, he was able to photograph sounds. The sound waves control the movements of the electron waves, which trace a complicated curve on a strip of photographic paper. "There are eleven distinct vowel sounds in the Indo-European languages, which include English, German, Persian, and Urdu, or (Continued on page 169)

New Highway Runs through a Skyscraper

TRAFFIC will pass directly through a skyscraper in a unique project now under construction in the very heart of New York City. One of the principal highways of the city, leading to a great railroad terminal, the Grand Central Station, is to pierce the thirty-two-story structure with twin tunnels. When the work is finished, you will be able to drive into the building at street level, climb through it on an inclined roadway, and emerge at the other side on an outdoor elevated roadway that circles the station itself at a height of one story above the street.

When a site for the new building was considered, there seemed no place to put it, in that congested district, save in the street itself. The engineers who boldly did that very thing not only provided an outlet for the traffic that would otherwise have been dammed but also laid out an elevated highway plan that will actually improve traffic conditions existing before the building was erected.



This photograph shows construction of part of the new New York Central Building and a section of one of the motor highways that will run through it, connecting the two sections of Park Avenue that the building breaks.

Know Your Car

THE modern motor car engine is equipped with several devices that materially reduce the amount of carbon that ordinarily would be deposited on cylinder head and pistons.

In spite of modern improvements, the motor still will carbonize rapidly if certain precautions are not observed. The use of poor oil, for instance, will result in a heavy carbon deposit. Adjusting the carburetor to supply an over-rich mixture also causes rapid carbonization.

Gasoline is composed of hydrogen and carbon. When mixed with the proper quantity of air the carbon burns to carbon dioxide and the hydrogen burns to water vapor. If, in the attempt to facilitate starting a cold motor, an excessive amount of gasoline is mixed with the air, carbon monoxide is formed and the extra carbon molecules collect on the cylinder head, pistons or valve stems.

Meteorite Wrecks Garage Repair Car

WHEN Reese Worick, a Lexington, Ky., garage man, was attaching the derrick of his wrecking car to a disabled automobile on a country road recently, there was a loud report, and his machine was struck by what he supposed was a bolt of lightning. Worick was stunned, but when he recovered and investigated, he found the derrick had been broken by a smoking hot ball of metallic substance, about the size of an orange, which lay in the car. It was evidently a fragment fallen from a meteor.



The Moon Makes Clocks Vary

AFTER an exhaustive study of the running of clocks through long periods, Dr. Robert R. Morgan, of the Naval Observatory, Washington, reaches the astonishing conclusion that they go more slowly when the moon is in the western part of the sky. The difference, however, can be detected only by the most delicate measuring instruments. When the moon is in the west one half of the day is .005 of a second longer than the other. Dr. Morgan told scientists at the recent astronomical convention at Yale University.

The convention was told that the spectra of 225,000 stars have now been classified. Professor W. S. Adams, of Mount Wilson Observatory, said his studies convinced him that the atmospheres of giant red stars, such as Betelgeuse, were much more dense than the sun's and might be several hundred thousand miles deep.

Toy Cars Teach Traffic Rules

TOY automobiles and trolleys are the latest devices great cities are using to teach their drivers safety. The applicant for a license to drive a motor car in Los Angeles must now demonstrate his ability to meet emergencies and his knowledge of traffic laws by running a model car on a table representing a busy highway. An instructor asks the student: "What would you do if this car came out of a side street?" asks the inspector, illustrating with a toy automobile observing his pupil's response.

Chicago's drivers of heavy trucks, too, learn safety with the aid of models on a miniature street crossing. It includes a traffic light signal and is magnetically operated by a constructor.



Upper photo: A Chicago mail truck driver being instructed with toy cars on miniature street intersection, equipped with traffic signal. Lower photo: Applicants for driving licenses in Los Angeles being tested. On model streets full of toy cars they demonstrate their fitness to drive in traffic.

How Much Do You Know of the World You Live In?

TEST your knowledge with these questions, chosen from hundreds sent in by readers. Correct answers are on page 158.

1. What great capital city was built in a swamp?
2. Where is the densest forest in the world?
3. What American island is more than seven miles high?
4. Where do houses have only three sides?
5. Where is radio used in land surveying?
6. What is the rainiest state?
7. Where can you experience summer heat and winter cold in the same day?
8. Where do gorillas live?
9. Where do the lost tribes of Israel live now?
10. Where can winter sports, like tobogganing, be practiced near the equator?
11. What mountain is named from a cloud?
12. Where does timber grow in water?

Stile for Motor Cars Only

A NEW style stile has appeared on the farms of Willard and John Deaver, at Viroqua, Wis. Utilizing the principle of the garage greasing platform, these farmers have built novel bridges over their fences, thus enabling them to drive from the road into their barnyard and to their garages without the trouble of getting out to open and close the gates. Moreover, this twentieth century stile is just as practical as the old, for it effectually prevents the escape of livestock. When repairs are made under the car it serves as a raised platform. Scrap boards and planks were all that was needed for the structures.



These wooden ramps on the Deaver brothers' farms in Wisconsin enable their cars to cross fences without opening and closing the gates, saving time.

Old Motor Car Frames Make Breakwater

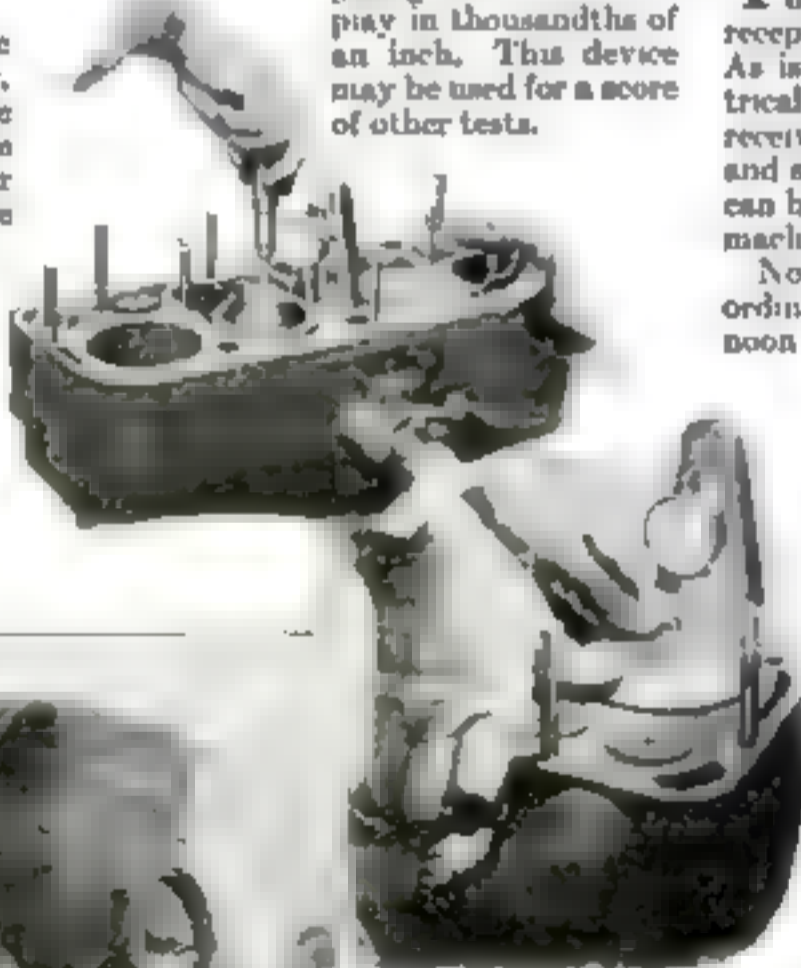


Automobile frames, wired together and anchored to the shores, which caught driftwood and debris and made a breakwater in the Platte River flood, averting great damage.

Simple Auto Bearing Test

IT IS now possible to test automobile bearings for play or looseness without taking the parts down. A cleverly constructed gage accomplishes the work easily and quickly, as shown in the photos below, with only the cylinder head of the engine removed.

The gage is held in position by a magnetic stand, and a vertical arm attached below the dial is rested on the top of the piston to be tested. With a rubber vacuum cup the mechanic moves the entire piston and connecting rod assembly according to its looseness. The motion moves the vertical arm which is connected with the registering mechanism, giving the amount of play in thousandths of an inch. This device may be used for a score of other tests.



Two tests for looseness in automobile engines. Above: A magnetic stand holds the dial, to which is attached an arm that rests on piston top. When the piston is moved with a vacuum cup the play is registered on the dial. Below: Testing sides of piston head by pressure.

WHEN the Platte River recently became unruly near Fremont, Neb., it was found that discarded automobile frames wired together and anchored to the shore served to catch driftwood and sediment and form a breakwater.

How Cyclones Grow

TWO mysteries about cyclones and cyclonic storms that have long defied solution have just been explained by Dr. W. J. Humphreys, meteorological physicist of the U. S. Weather Bureau, who, after study of the records of such

storms covering many years, is able to show why they grow in size and intensity as they move northeastward and why the increase is greater by night.

Such storms, says Dr. Humphreys, consist of a swirl between cold air on the northwest side and warm humid air on the southeast. The contrast increases as the storm moves northeast—the cold side becoming colder, although there is little change on the warm side—hence the storm becomes greater. Also at night the cold side, being generally clear, grows colder by radiation, while there is little change in the cloudy warm side.

Law Bars Radio Interference

THE first law prohibiting the running of machines that interfere with radio reception is claimed by Fairfield, Iowa. As is well known, the operation of electrical machinery in the neighborhood of a receiving set often causes interference and spoils an evening's program; nothing can be done about it unless the offending machine can be turned off.

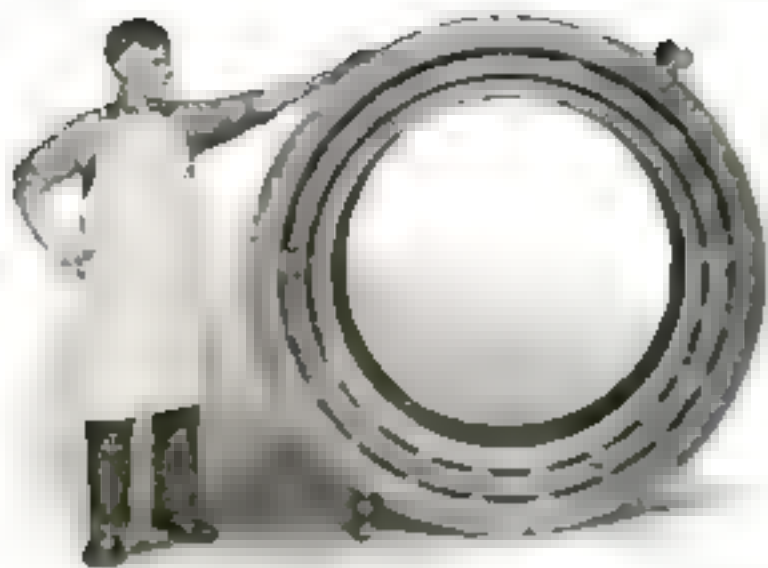
Now this college town of 5000 has an ordinance prohibiting the use between noon and midnight of vacuum cleaners, washing machines and any other devices that may interfere with radio reception. Violators of the law face fines of \$100 or thirty days in jail.

Self-Winding Watch

A WATCH that winds itself is the amazing invention just reported by Karl Heinrich Meyer, a Swiss watchmaker, who, if his claims are true, has added one more to the imposing list of achievements of a people whose name has become almost synonymous with the word "watch."

The power necessary to keep the minute mainspring at the proper tension is said to be derived from the expansion and contraction of a drop of glycerin contained in a chamber inside the watch. The ordinary changes of temperature of any climate are said to be sufficient to cause contraction and expansion, since only a two-degree variation keeps the watch ticking accurately.

The invention suggests the possibility of operating power machinery by a similar method.



Jumbo of Roller Bearings

PROBABLY the largest of its kind in the world is the gigantic roller bearing recently completed by an Ohio firm as one of a set to be installed in a huge cement mill. It has a diameter of more than five feet, and two tons of force is required to lift it. Within its rugged rim will rest one end of a thousand-ton grinding mill revolving thirty times a minute. Roller bearings, despite their extraordinary size, were preferred for this work because, requiring only occasional lubrication, they could be completely inclosed to guard against cement dust.

New Bridge Inside Old One

ONE of the most singular of modern bridge building exploits has been decided upon by engineers who will borrow one of Nature's peculiar methods in replacing an old structure at Bound Brook, N. J., that carries interurban lines and vehicles. The method adopted is not unlike that of the snake that grows a new skin and then gets rid of the old.

By the arc-welding process, which was described in detail in last December's *POPULAR SCIENCE MONTHLY*, virtually a complete new bridge will be built of steel inside the old one, which will then be taken down.

Lighter Aluminum for Planes

A NEW aluminum alloy so much lighter than any heretofore known that it will revolutionize flying is claimed by Dr. Max Wurmback, a Munich metallurgist, who declares that while it is lighter than any other metal known, it is stronger than iron.

Used in the manufacture of aircraft, says Dr. Wurmback, his alloy would materially reduce the weight and consequently cut the lifting requirements of the motive power.

The inventor refuses to disclose how he produces the metal, which he calls "alneon," but he does say that his whole secret is in the process of cooling. Otherwise the alloy is much like other aluminum combinations.

Radio Photos by Air Jet

RADIO engineers at a recent convention in New York City were amazed when they sat in a theater and saw photographs transmitted by radio and so enlarged that they covered a screen that filled the stage.

The demonstration was by Captain

Richard H. Ranger, inventor of the Ranger system of radio photo transmission and an engineer of the Radio Corporation of America. The device he used was the "photo-radioscope," which, responding to the radio signals in much the manner of other radio photograph receiving systems, sends jets of hot and cold air against a sensitive screen, the differences in temperature determining which parts of the screen shall appear in various degrees of color.

While transmitting and recording processes are still too slow to show scenes of actual activity, Captain Ranger has demonstrated that if the speed problem can be solved, events such as prize fights can be recorded in large enough proportions for theaters.

\$400 Aero Fare to England

EVEN the rates of fare have been tentatively decided upon, so certain are the builders of the British super-airship, the *R-100*, twice as large as any other dirigible, that they will establish trans-Atlantic service.

Commander Charles Burney declared in a recent statement that his company, which built the *R-100* for the British Government, had decided to exercise its option to buy the craft for its own operation. The machine is scheduled for completion this present spring, and trials are expected in July. Commander Burney said the flying time will be forty-eight hours westward and thirty-eight hours eastward. Arrangements to carry mail have been made with Great Britain, and negotiations with Canada and the United States are under way. The tentative passenger rates are from \$400 a berth in a four-berth cabin to \$600 for a single-berth cabin.

The plan had been to use the huge aircraft in an England-Australia service.



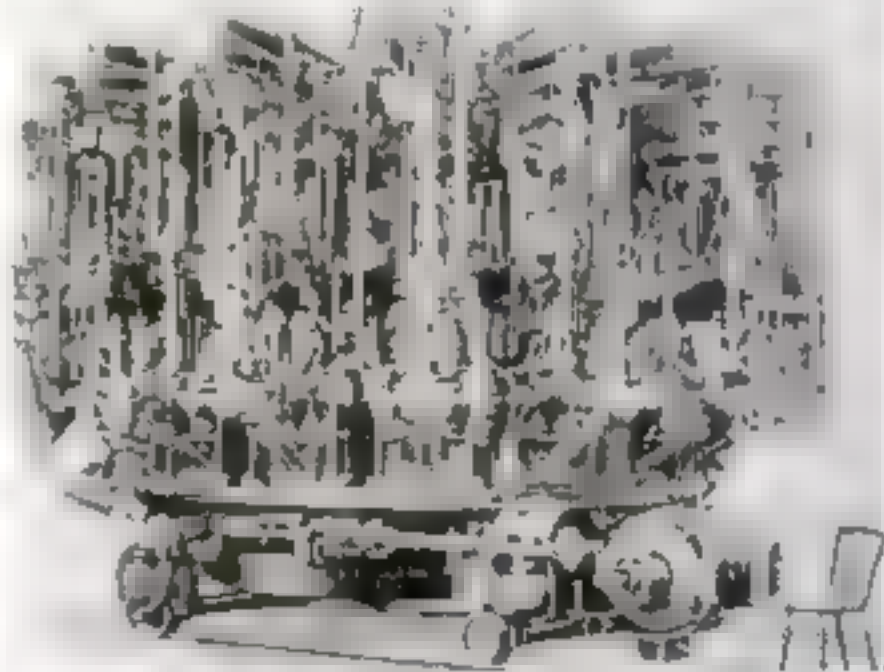
This machine prints railroad tickets as they are bought, giving destination, price and date, and also records the sale, saving labor of bookkeeping.

Complicated Bottle Machine Makes One Million in Week

MORE than a million bottles a week each may be manufactured by two remarkable machines built in England for use in Japan! The mechanisms are staggering to the imagination in their complicated mass, yet Francis Redfern, their inventor, has had no previous experience in machine construction. He is a solicitor in John Walker and Sons, Ltd.

In early days, bottles were made by blowing into molten glass through long tubes, but here we have a machine with fifteen separate bottle-making units, each of which automatically picks up liquid glass and forms it into a bottle as the entire device revolves past a large pot containing the raw material. So quickly does each unit draw the glass and do its work that 120 pint bottles are turned out every minute!

The Metropolitan Vickers Electrical Company, Ltd., made the device. The picture below is reprinted through courtesy of *The Illustrated London News*.



Fifteen separate units on this complicated revolving machine pick up molten glass from a container as they pass it and form it into pint bottles. The total capacity of this machine is 120 bottles a minute.

Rail Tickets Printed on Spot

RAILWAY stations need no longer go to the trouble of stocking thousands of tickets, now that an ingenious automatic machine has been introduced that prints the traveler's ticket as he steps to the window and names the city to which he is going. Not only does the new machine print the passenger's destination, but it also stamps the mileage and fare on the card and keeps a record of each ticket printed, thus saving a great deal of bookkeeping on the part of the station agent. At left the device is shown delivering a sample ticket.

Your Queries Answered

THIS magazine is glad whenever possible to answer reader's inquiries regarding subjects within its scope, and to supply names and addresses of manufacturers of articles described in its pages. Enclose self-addressed stamped envelope and address Information Department, *POPULAR SCIENCE MONTHLY*, 250 Fourth Avenue, New York City.

Bird Flies Across Atlantic Before It Is 3 Months Old

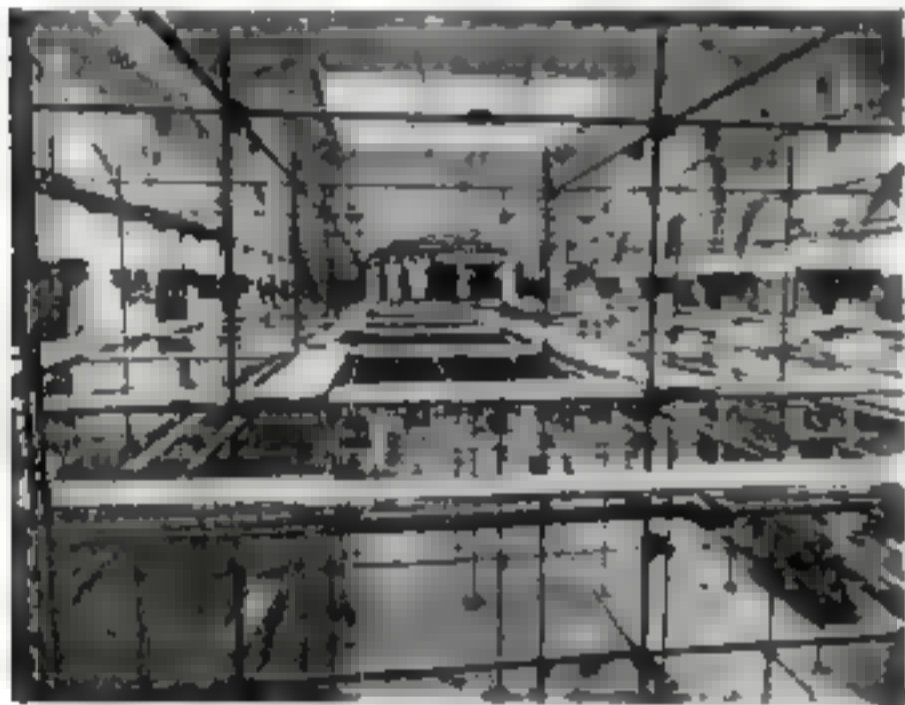
AN AMAZING 4200-mile trans-Atlantic flight of a bird, recently announced by the Biological Survey, shows that even Lindbergh has something to learn from feathered flyers.

An Arctic tern between one and five days old was banded and released July 22, 1927, at the Red Islands, Turnevik, Labrador, by O. L. Austin, visiting the birds' breeding grounds for the Survey. On Oct. 1, 1927, the bird was found near La Rochelle, France, by Robert Pradier.

This is the second transoceanic flight mentioned in the Survey's records, but the first bird took its time—four years.

Steel Scaffolds Replace Wood

SCAFFOLDING of steel tubes rather than wood has now been developed to eliminate fire danger, warping, and failures of structure that have caused many fatalities. The long metal tubes, fitted together with couplings and collars,



Stronger than wood and more easily transported and erected, this tubular steel scaffolding is also proof against fire and will not warp. It is here shown erected in a great hall for renewal of ceiling decorations.

Steel Balls Bombard Nonbreaking Goggles

TESTING the strength of goggle lenses by dropping a steel ball on them was an unusual experiment performed in Chicago recently when the National Committee for the Prevention of Blindness met with the National Society Council to discuss eye hazards in industrial occupations. The new method, which releases a falling missile from a magnet at the touch of an electric key, was used to show the strength of nonshattering glass used in modern eyepieces.

By the systematic use of goggles in one great industrial concern alone, the eyes of a thousand men have been saved, according to a recent estimate. Nevertheless, many men in industry neglect these precautions. In Pennsylvania the sight of 6842 eyes has been lost in industrial accidents since 1916. Many of these injuries goggles would have prevented.



To test lenses of nonshattering goggles that must resist flying metal, steel balls are dropped on them from a magnet at touch of an electric key.

as shown below in the photograph, make a framework of great strength. Recently an eight-ton stone block was easily raised to a height of seventy-five feet without menace to the newly invented scaffold.

These frameworks are more open and consequently less menaced by the wind. Bracing formerly called for is of little necessity, and since the interchangeable parts are less bulky, they may be easily stored, transported and erected. Wood is used only for platforms and is specially treated to make it fireproof.

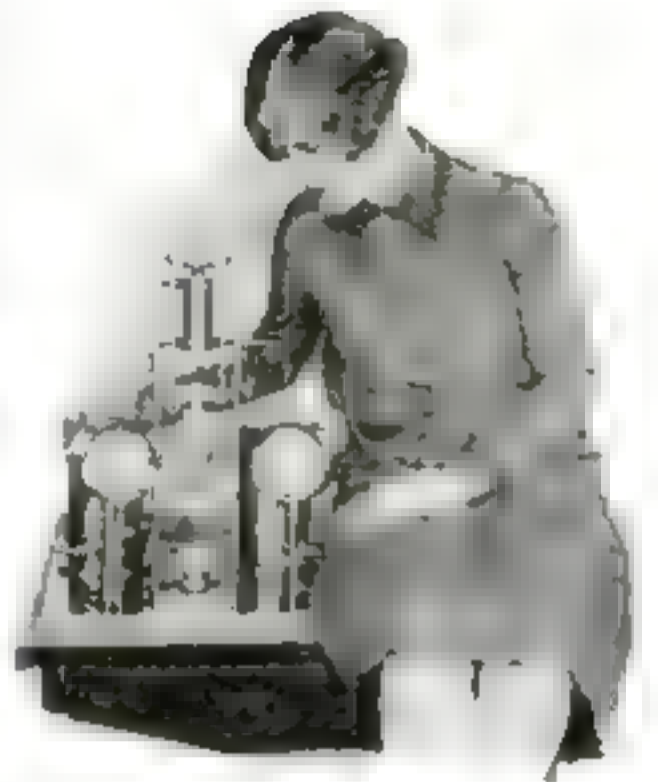
Hiking Cane Has Tail-Light

FROM Europe come reports of three new inventions that, while probably not revolutionary, should certainly take prizes among the month's quaint and curious products of the inventive mind.

Among patents recently granted in England is one for a walking stick with a red tail-light for persons walking on highways. The cane is provided with a tiny bulb and a battery, whose circuit is completed when tapped on the ground.

Two French engineers named Vallee and Aupere have invented an apparatus that reproduces the notes of the nightingale and other birds, which they propose to substitute for ordinary telephone bells.

The third odd invention was introduced to Parisians who stopped to look at a new motor car in a display window and heard the machine say, "Before you, you have the famous 1914 1928 model," and then reel off a fine selling talk. The car contains a phonograph that talks whenever prospective buyers appear.



Machine Tests Marcel Waves

HAIR tension tests may be the next addition to the staggering list of offerings of barber and beauty shops. Since marcelling is said to make the hair brittle, we now have this highly sensitive machine whose indicators show the degree of strain the tresses can undergo.

This use of the device is a new one, for its primary purpose was the testing of such delicate pieces as hair springs, filament wires and loudspeaker diaphragms. In the latter cases, the amount of punishment these fragile units will take while in operation is accurately recorded. P. L. Irwin, research engineer of the Westinghouse Electric and Manufacturing Company, is the inventor.

Porcupines Don't Shoot Quills

THE popular belief that porcupines shoot their quills is a myth, according to Vernon Bailey, distinguished zoologist, of Washington, D. C.

"When met with," he says, "the porcupine tries to escape, but if crowded it bristles up, erects its quills and stands at bay. As the enemy approaches within reach three blows of the heavily armed tail are struck and the barbed quills are thus driven into anything within reach."

New Smoke Alarm

A NOVEL new use for the photo-electric cell has been found in Pittsburgh, where it is employed in a newly invented device to warn engineers of industrial plants when smoke from their chimneys is exceeding the density allowed by law.

A beam of light is kept constantly in the chimney and pointed at a photo-electric cell, which is so sensitive that it sends to the engine room an exact record of the density of smoke. The transmission is made by an electric current that the cell operates. The engineer constantly has before him an indicator that shows whether he is keeping within the law that limits the density of the smoke.

New Inventions That Everyone Can Find Useful

Hand Bag Atomizer

Perfume or throat spray is conveniently carried in this recently patented atomizer from France. The liquid issues from one end at pressure of a finger on a spring telescoping tube. The atomizer is leak proof.



An Accident-Proof Baby's Bottle

The infant is prevented from spilling, dropping or throwing his bottle by this new holder, which is easily attached to carriage and has an arm just flexible enough to permit its proper adjustment. The novel device fits bottles of all sizes and shapes.



Mantel Clock Is a Savings Bank

"Time is money," we are told, and this novel clock proves it in a new way, for unless two coins are dropped each day into the savings bank attachment the timepiece quits running. The clocks are distributed to depositors of a Western bank to encourage thrift. When the coin repository is filled it is removed at the bank and replaced to be refilled. The savings device that controls the winding of the clock is located in the back where it cannot be seen by anyone looking at the clock standing on the shelf.



A Nonswaying Rope Fire Escape

Swaying and twisting, common faults of rope fire escapes, are impossible in this new English ladder. Metal projections, placed at intervals, serve as rungs and grip the wall, making the device almost as rigid as a wood or metal ladder. The ladder, shown in use in a fire drill, folds into small space, and should prove useful in private houses as well as in factories, schools, theaters and office buildings.

Finest Sewing Kit

Thimble, scissors and spools are each set in this new French set and the thimble forms the cap for the case. Needles are carried in a compartment inside the spools.



"Vulcanizing" Socks Saves Darning

Utilizing the tire repair method, you can now "darn" your socks by cutting pieces of special adhesive fabric to cover the holes and sticking them on with a hot iron. The fabric is obtainable in all colors and textures in which socks come.



Lemon Juice Filters Pipe Smoke

Dip the flared tube of this pipe stem in lemon juice before smoking and the juice is said to absorb more than a third of the nicotine. If water is used instead of lemon juice 19 percent of the nicotine, it is said, is absorbed in the filter.



A Leg-Operated Accelerator

This adjustable accelerator is worked by the leg, leaving both feet free for the pedals.



The Slot Machine Manicurist Now

The latest slot machine device is this nail suffer to be used after washing has taken off the polish. The buffer starts work in its minute of a revolution by the push of a button. W. S. Smith, the German patent is shown demonstrating the new device.



A Quick Drying Shaving Brush

A novel release device permits the bristles to spread and dry in a hurry, a boon to travelers. By the use of a small triangular



Removable Lights

Rather than removing lighting fixtures for cleaning and use is eliminated. It is held by an ingenious springing socket that makes it possible to hook and unhook the entire fixture as a single unit. Hook is shown in circle.



Now a Player Accordion

No pump is needed to play this new accordion, which is made to produce any desired notation by means of a roll similar to those of the ordinary player piano. The speed is regulated by hand pressure on the lever that engages the roll and makes it turn.

Duplicating Typewriters

A new duplicating device might be said to give one typewriter the capacity of twelve ordinary multigraphing machines. The letter is recorded in perforations on a paper roll. When fed to the machine, the perforations on the roll operate the proper keys.



New Parcel Sealer

Quicker time is set to this parcel sealer, which is designed for use in the home and in the office. The machine is made of metal and is a sturdy, reliable device. It is easy to use and is a great help in the home and in the office. Another advantage of this device is that it has no springs to get out of order.



An Inside Motor Spotlight

You need not put a hole in your windshield to install this new spotlight for the inside of your car. For those bodies it is attached by a bracket just above the instrument board, where it is most convenient for the driver's grasp, and it shines through the windshield. If desired the device can be removed and used as a trouble light to find what is wrong in any part of the automobile.



New Motorcycle Machine Gun

BOTH quick arrival on the scene of action and fast retreat are possible with the new motorcycle machine guns recently added to French army corps. Besides the important feature of the ease of portability of the light but deadly rifles is a special universal mounting that gives high elevation and enables the gunner to train his weapon on enemy planes as well as infantry. The guns when not in use are carried in cases on the sides of the motorcycles. Demonstration was recently made at the French army maneuvers at Satory Camp.

Air Unearthing Buried City

COMPRESSED air excavating apparatus has been pressed into service by men working under the direction of Prof. Amedeo Maiuri, eminent Italian archaeologist, in the latest effort to uncover the centuries-old ruins of Herculaneum, near Naples, Italy. With this modern aid of science they hope to unearth historic treasures even richer than those of Pompeii, another Italian city that was buried in the same eruption of the volcano Vesuvius in A.D. 79.

Only ashes covered Pompeii, and most of its treasures were dug up and carried away soon after; but Herculaneum lies beneath masses of solidified mud and lava that have remained undisturbed for eighteen centuries. In recent years haphazard diggings revealed relics of inestimable value; and the present systematic excavation, under the official auspices of Premier Mussolini, is the result.

Biggest Shovel Lifts 24 Tons

MATERIAL could be lifted to the top of a ten-story building by a giant electric shovel, the largest in the world now being constructed by the General Electric Company. Placed in the center of a football field, it could dig out the entire field without moving from one position, and deposit the dirt from the excavation in the stands.

Its 120-foot boom will be terminated by a dipper stick eighty-two feet long, and a scoop that can pick up fifteen cubic yards of earth or coal, weighing nearly twenty-four tons, at a single stroke. The mammoth shovel will be used in the open pit mining of coal, at Danville, Ill., where a 1000-foot cable will supply the 4000-volt electric power to run it.

Odd Parachute Square in Form

SHOULD experimentation with the new square shaped parachute pictured below be successful, all the Navy aircraft will soon be equipped with it, for it is said to embody many new safety features. In the recent tryouts at Lakehurst, N. J., life was not risked; dummies, the weight of a man, made the test drops.

Parachutes were originally designed for spectacular balloon descents, the first really successful drop being made by Andre Jacques Garnerin, a Frenchman, in 1797. The word "parachute," it is interesting to note, signifies "fall-breaker."



The strange square parachute, which may be adopted for Navy aircraft if its claims to safety are sustained, is tried with a dummy.

Device Aids Short Wave Radio

THAT the possibilities in short wave radio—considered unimportant a few years ago but now commanding interest by leaders in the new science—are far from exhausted is again indicated by discoveries of Abraham Esau, of Jena, Germany, that have resulted in his invention of a method to increase the power of short wave broadcasting.

Esau has discovered that a wire gauze placed on the surface of the earth under the antenna reduces the earth-current losses to a minimum, thus conserving virtually all the energy for radiation and giving greater distance. The network must be three or four times the wave length being used.

Esau provides also for the saturation of the earth beneath the antenna with some chemical agent, the nature of which he does not reveal. This improves the conductivity, he says.

Pilotless Plane Loops Loop Under the Control of Radio

PILOTLESS planes have just been made successfully to loop the loop by wireless control from the ground, according to recent reports from England, where intensive research is being made in radio piloting. Other amazing maneuvers are made as easily possible with the delicate new governing system within the plane, operated by radio waves alone.

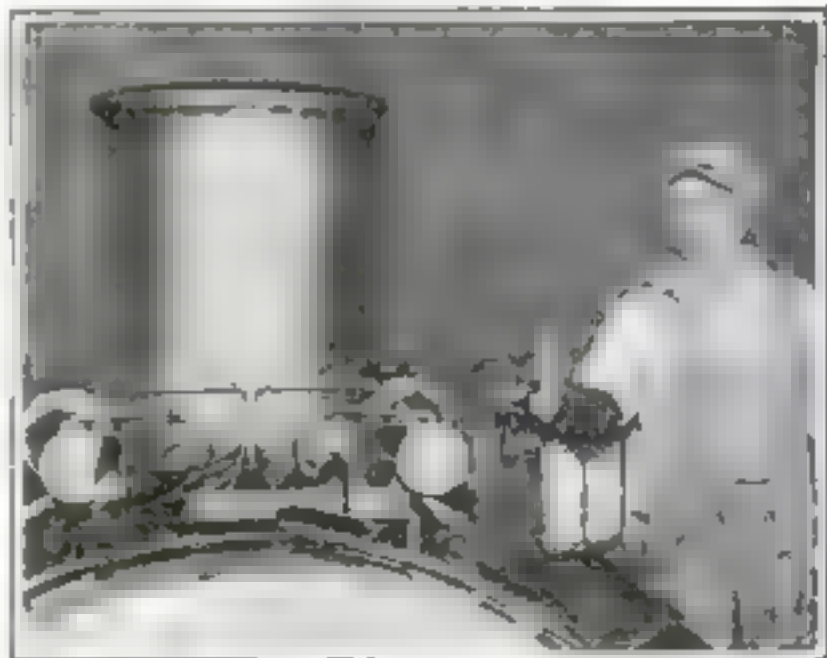
The mechanical pilot's "brain" is a radio receiving set within the plane designed to interpret and act upon impulses transmitted from a ground control station. The "muscles" are tiny compressed air motors, actuated by the master radio set. These operate the controls.

Lindbergh Epic on Post Card

BY WRITING, in 10,052 words, the complete story of Col. Lindbergh's history-making flight to France on one post card of ordinary size, Conrad Kemper, young German artist, declares he has achieved a world's record for small and legible chirography. To the naked eye his writing appears simply as very fine, even, wavy lines. Under a magnifying glass the words appear, written in a clear, beautiful hand. The card represents three months' work, performed with a hard pencil without a glass.

Multiple Locomotive Sirens

SHRILL sirens, much more audible at three miles than the ordinary whistle and designed to lessen the numerous automobile accidents at crossings, were recently placed on the locomotives of two local passenger trains of the Southern Pacific lines in California. Sets of four were installed, each operating as a unit with the others in order to give a single warning tone. The sirens, which are shown below, are fitted immediately behind the engine stack and pointed in different directions to insure wide range and thus give greater warning efficiency. Sound is much affected by atmospheric conditions, topography and buildings, so that a blast from a single whistle cannot always be heard for any great distance in a specified direction. The four sirens eliminate this.



One of the sets of four sirens on Southern Pacific locomotives, pointing in different directions so warnings will surely be heard.

Submarine Safety Device Is Donated to the Navy

A DEVICE by which a submerged submarine may signal to the surface to indicate its position and avert collisions has just been presented to the Navy Department by the Human Research Corporation, of Philadelphia. The invention of Dr. Isadore Kitzee, it has not been manufactured, but the patents are donated to the Government, which will consider it among other plans for making submarines safer, as mentioned in an article in last month's issue of POPULAR SCIENCE MONTHLY.

The equipment provides a submarine with ports from which signals can be sent up. The operation of the signals can be carried on electrically from all compartments, so that in case of accident men left alive in one compartment as they were in the S-5, would not be powerless to send word to the surface.

The signals would be floating indicators visible or audible or both.

How Industry Uses Sawdust

SAWDUST, which some of us may have thought pure waste, has so many uses in industry that large concerns gather, classify and sell it by wholesale. Some 30,000 tons a year are used in meat curing—hickory mainly, but also oak, mahogany and other hardwoods. For filling plaster board more than 22,000 tons are used, and more in composition flooring in large buildings. In packing grapes 4000 tons of spruce and Douglas fir are used. Moistened and sprinkled on the floor of cars in which nursery stock is shipped, it keeps the plants from drying to death.

Giant Rotary Plow

GREAT rotating cutters are the new features of a giant plow recently introduced in England and designed for doing much work in a hurry on large plantations.

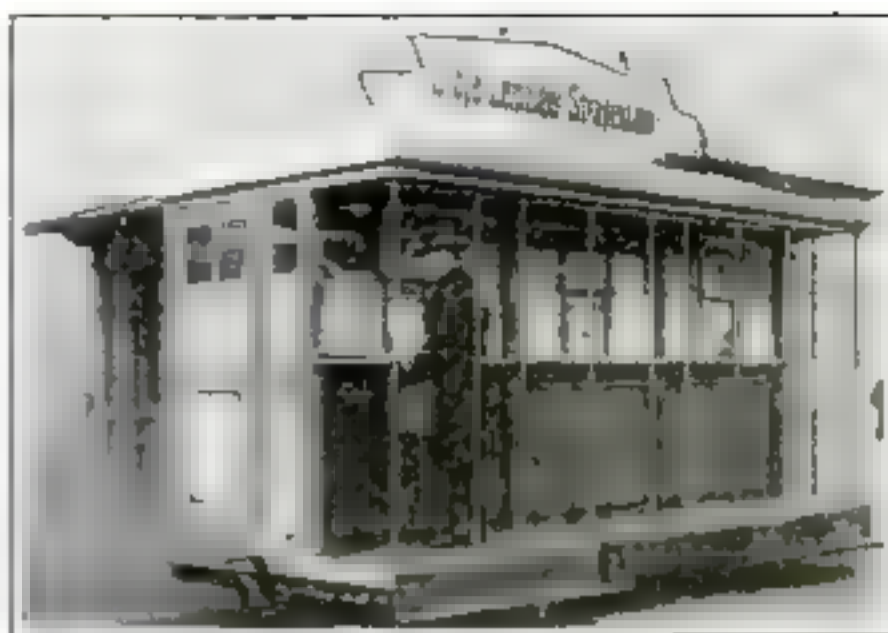
The two powerful digging wheels operate in opposite directions as the tractor moves along and, since each cutting wheel is equipped with three shares, the ground is thoroughly turned up in curving lines that cross each other again and again. Joints permit the

cutting wheels to be lifted while the machine proceeds to the ground to be plowed.

Plane Speedier With Pontoons

ARMY engineers were amazed recently by tests on Staten Island, N. Y., and Long Island, N. Y., flying fields in which one of the Army's four observation and attack planes, Curtiss Falcon models, flew faster with pontoons than with wheels attached to its landing gear—upsetting all past experience.

Equipped with a large float designed by Arthur B. Beisel of the Curtiss engineering division and with two small wing tip floats, the plane crossed New York Bay at 148 miles an hour—whereas the best it had ever done with regulation landing gear was 147 miles. It took repeated tests to convince the skeptical engineers.



Rail Ticket Booth on Wheels

COMMUTERS who are tired of going to the station for their tickets will be interested in this German innovation by which the tickets come to the commuters. In order to facilitate the selling of weekly tramcar passes, this traveling ticket booth has been put in operation by the Leipzig tramway and has proved a great success by reason of its greater range of distribution.

Discoveries Upset Race History

EVIDENCES of a tremendous migration of Asiatic peoples to southern Africa and Madagascar more than 2000 years ago have been discovered by Dr. Ralph Linton, assistant curator of Oceanic and Malayan ethnology at the Field Museum of Natural History, just returned from more than two years' research in Madagascar as head of the Captain Marshall Field Expedition. His report upsets many long accepted theories of racial history.

The invaders probably were driven by foreign tribes from their homes in the region of Java. One group braved the 3000-mile voyage to Africa and Madagascar; the other went to Pacific Islands. The Indonesians exterminated the pygmies of Madagascar, Linton says, but those landing on the west coast of Africa were destroyed by Zulus and other African tribesmen.

Linton's conclusions are based on comparisons of cultures of Madagascar, African and Pacific island tribesmen and on revelations from Madagascar natives of history handed down to them.



Just Like MacMillan Ship

HARD rubber forms the entire hull of this new toy sailing ship, which would have a particular appeal for the boy who is stirred by a love for the sea and its romance; for it is a 30-inch model of Donald B. MacMillan's Arctic schooner the *Bordona*. Great sport, too, is offered by the navigating possibilities of this ship, for the three sails may be raised or lowered at will and regulated with the rigger for any desired kind of sailing.

A Needle Injects Sauce in Chicken

SAUCES injected into fresh killed chickens just before roasting gave an entirely new flavor to the meat and provided a treat for a recent dinner of the Societe Nationale d'Acclimatization of France. The method was pronounced by cooking experts far superior to the ordinary external sauce method, since in the new process the meat itself is flavored in every fiber.

World Water Power Census

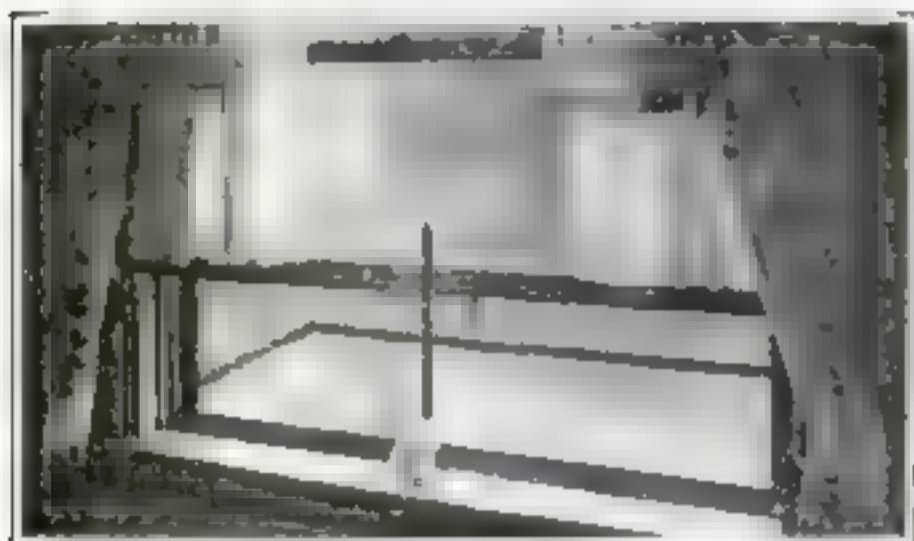
THE United States leads the world in utilization of water power and in the capacity of its plants using this power it equals nearly the whole of Europe, according to a remarkable world census of water power just issued by the United States Geological Survey.

The total in the United States for plants of 100 horsepower or more was 11,700,000 horsepower; for Europe, presumably for plants of all sizes, 13,100,000. From 1921 to 1926, inclusive, the increase here was 3,800,000 horsepower; in Europe, 4,200,000. However, the rate of increase is growing here and declining over there.



The digging wheels of this tractor plow, each fitted with three shares, rotate in opposite directions, cutting criss-cross furrows.

Household Duties Simplified by



Set the "alarm" of the clockwork window-closer above for a half hour before your rising time and a powerful little arm shuts the sash, cutting off the breezes that have brought you fresh air all night.



When your eggs have boiled for a sufficient time, a whistle in the tight fitting lid of the new cook pot pictured below announces the fact. Meantime you go about your household. Steam pressure operates it.



Here's a vacuum cleaner that needs no electricity to run it! Just push it over your carpets and across your floors. It generates its own suction that whisks dust and lint into its capacious bag. Rubber-tired wheels furnish the motive power that creates the vacuum, and the absence of electric wires is said to be an advantage in that it permits greater maneuverability around furniture and in odd corners.

Ice and drink are kept separate in an ingenious new pitcher that has a hollow glass cylinder at its center. When the tube is filled with cracked ice, the entire contents are chilled, it is said, yet the ice never touches the beverage. No pieces are likely to pop out as you are pouring, and the contents are kept free from dilution and from any impurities in the ice.



Who's at the door? To tell the housewife who is alone in the home whether it's a peddler, a tramp, or someone she wants to see, the new device at the right fits in the door panel. Its small, round barred window, opened, permits a look at the visitor and a word with him before the door is unlatched and opened.



The scrubbing pail seen at the left has a mop wringer built into it—a light, effective affair unlike the heavy lever attachments often used. Twist the mop in its cone-shaped sieve, and the excess water drains back into the pail. It is also said to be proof against splashing. The device is said not only to save time for the busy housewife, but to greatly reduce the labor needed in hand wringing or turning wringers.



Pancake griddle and waffle iron in one is this new electric utensil. To adapt the griddle to waffle-making, simply turn over the plates, which are flat on one side and on the other marked in the conventional waffle design. A switch controls current.



New Mechanical Devices



No fumbling in the dark for anything in the back of this new refrigerator. A door light in the top makes it as good as a thing of the past. It illuminates the entire inside and can be rotated even without hands. Within convenient reach of an arm or elbow is a toggle switch that is the answer with light. Cords are used in the refrigerator's walls, to prevent outside wiring against outside heat.



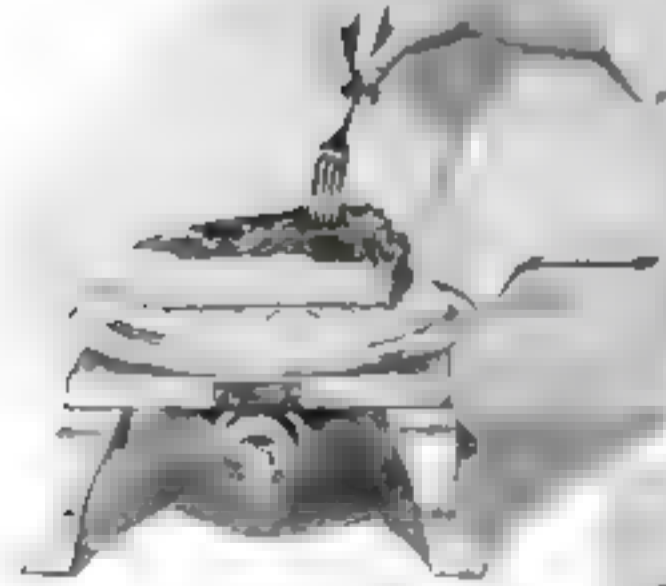
A very hot plate for warming steak, roasts, or hot for a roasted meat. These warmers hot as the food themselves are kept ready in the ready with a new electric plate warmer that has three levels. It is made like a steel oven over a built-in, any hot and a no expense in but perfect safety for houses and for use for restaurants and hotels.



Removable from its solid wire stand for leaning is an improved form of a stand. Should its wire mesh be damaged it can be detached in a few seconds. Wire loop handles make the removal and insertion of the plate in the new stand.



Delicious, appetizing doughnuts are made at your table with the new electric doughnut maker. Just invert the dough and the novel, even punches the holes. The even uniform electric heat is used to make the doughnuts more tasty and it avoids the bother of frying in deep fat. It makes four at a time, and takes about three minutes for each but less time than a trip to the store would take.



An orange becomes a drink with this speedy fruit squeezer. The fruit is put in the top and the feet are used to hold it firm. A juice-yet it is easily removed when you are through. Orange, lemon, or apple fruit juice is squeezed as it comes out of the spout.



Dripless and smokeless, this broiler says the maker, is the answer in cooking convenience. It can be used on gas, oil, or electric stoves, and besides broiling all kinds of meat it cooks apples, potatoes, muffins and pies. A metal oven fits over the food for baking and roasting. It also acts as a boiler when the heating appliance is too hot.



What to do with a coffee cup, a couple of sandwiches and some olives is a problem that a waitress may have to solve with the new, ray-ray tray. It will be handy by that person who has felt that anybody but a professional juggler would be out of place at a party. Its round-shaped design with separate compartments for up and food makes it especially appropriate for bridge parties. Back of the 'spade' is the handle.



Not all the model airplanes in the recent contest limited to rubber band motive power. Some children designed their own

Children Devise New Planes

HUNDREDS of boys—and girls too—of all ages competed in the recent city-wide competition in New York for model airplanes with rubber bands as their sole motive power. Not all the planes were of conventional design. In some the children had developed their own ideas, different from any of real aeronautical engineers, showing several construction plans that may some day be adopted for full size planes.

The contests were held in the Sheep Meadow of Central Park.

Food Rises in "Magic" Table

SOON you may enter your favorite restaurant, drop an order in a slot—and have your meal delivered up through the table! The novel device, which bids fair to make our service waiters, tipless and trayless, was recently exhibited as seen at the right, at an exposition in New York; and according to reports it will soon be used by several restaurants.

An order is sent through to the kitchen below. Presently a square panel rises in the center of the table, like the top of an elevator with several floors, bearing the soup course. The others follow at the proper times. The check, which even this marvelous device does not do away with, comes last. P. J. O'Rourke is the builder and J. Daschner the inventor.

Better Fur Cleaning Method

A NEW process for removing spots from furs does not destroy the luster or sheen of fur or leather trimmed garments, according to an announcement from the Bureau of Standards. Working with expert cleaners, Government chemists have discovered that a little paraffin added to the naphtha preparations ordinarily used in cleaning establishments protects the garments against injury.

Chemical Snow Replacing Ice

"CHEMICAL snow," once only a novelty, is finding increasing use in the field of refrigeration, and is now manufactured by the ton. It lasts longer than ice, and when it is all gone, eva-

porated into air, not even a wet spot is left to show where the snow was.

With the new refrigerant ice cream is now shipped from New York to Cuba. A shipment of fish to Detroit, which would require 17,000 pounds of ice with two or more stops for re-icing, takes only 1200 pounds of the snow. Ice cream packed with the snow weighs only one third as much as if packed with ice. In ships and storerooms it eliminates the expense of refrigeration plants. Under certain conditions this substance is said to be fifteen times as efficient as water ice. Its temperature is from 110 to 114 degrees below zero. It is produced by liquefying carbon dioxide gas and solidifying it under pressure.



After the order is dropped down through a slot to the kitchen, this elevator of several stories brings the food course after course, in the center of the table. The builder, P. J. O'Rourke, left, is seen with the inventor J. Daschner.

A. J. Hosier, Wiltshire, England, farmer, hauls milking stalls to his cattle in the fields with a tractor. It is cheaper than herding them to barns and he says their open-air life helps them produce better milk.

Aero Engineers Aid Farmer By Improving His Windmills

AERONAUTICS, after adapting the windmill to its own purposes, is returning it to the farmer greatly improved as a result of the intensive research made by the aircraft industry in the field of aerodynamics. Changes in the number of blades and the pitch of the propellers used to drive electric generators on airplanes at the Army laboratories at Dayton, Ohio, have resulted in the adaptation of a new type of wheel for ordinary windmills that increases the speed of revolution from six to ten times that of the old-fashioned wheels.

Stupendous Hand Sawing Job

THE biggest job of hand sawing ever heard of in this age of power machinery is being undertaken by Captain Jacob Wilson, sailor-sawyer of Sawyer, Wis., who spent last summer demolishing a breakwater in Green Bay, Wis., in order to saw it up for firewood. It will be about a year in all, he estimates, before he finishes the job of cutting the wood into splitting sizes and getting it ready for the market.

The captain is perhaps the oldest living master of lumber-carrying vessels in the Great Lakes region. He gave up the sea for the firewood business because of his advanced age.

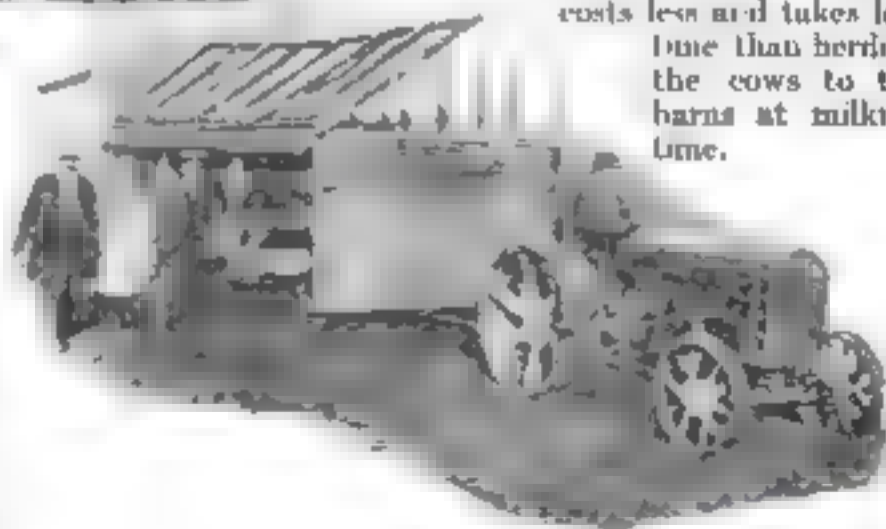
Mining Record Smashed

MORE than eleven million dollars worth of minerals was produced in North Carolina during 1926, exceeding the previous year's production by \$400,000, according to figures of State Geologist H. J. Bryson and the United States Geological Survey. This sets a new mark for the state's output, although these figures do not include cement products, which were in excess of \$1,000,000.

He Takes Stalls to the Cows

THIS English farmer violates accepted tradition each day—he brings the stable to the cows! But A. J. Hosier, of Wexcombe, Wiltshire, England, has his reason. He has found that living entirely in the open in good weather is healthier for the cows and, moreover, results in better milk. Therefore he has evolved a system of open-air dairying, pulling his portable milking stalls to his herds out in the fields with a tractor.

Another advantage of this method is that it costs less and takes less time than herding the cows to the barns at milking time.



Chain Drive Roller Skate Goes to "Patentees' Court"

DURING a recent annual international exhibition of inventions in England a "court" was formed at the Institute of Patentees to deal with the gigantic task of selecting the devices most worthy of display from the mass of odd and ingenious products of inventors' fertile minds. This illustration shows the court, with Capt. G. Drury Coleman presiding, examining some of the models. Among them were a coal shovel that automatically rejects small lumps and a mechanical roller skate propelled by chain drive.



The "court" of the Institute of Patentees in England determining whether some of the strange devices deserve exhibition. Capt. G. Drury Coleman (center, rear) is presiding. A coal shovel that automatically rejects small lumps and a chain drive roller skate are among the inventions.

Harem Buried with Ur's King

EXCAVATIONS in Mesopotamia made recently at the grave of a king of Ur revealed that other bodies than that of the ruler were buried in the one grave. In the fourth millennium before Christ it is apparent that the state took a woman's life if her husband died, at least in the case of the monarchs, for in the grave, besides the king's gaming board and dice, were the bodies of his wives. Further excavations brought forth the bodies of his servants and musicians.

"We found the bodies," states C. Leonard Woolley, director of the expedition, "not properly laid out for burial, but huddled up as if death had overtaken them suddenly. There can be little doubt that these women comprised the harem of the king, yet it was not their grave. They were chattels which the king took with him in case he might have need of them hereafter, just as he took his silver and gold vessels and set of spears."

Kiddy Car Has Plane Motion

NEW among riding toys for small children is a kiddy car of unique design built to represent a monoplane, seen in the illustration below. A rocking motion which gives the young aviator a sort of aeronautical swoop as he rides down the sidewalk is one of the special features and is brought about by an off-center wheel fitted below the "fuselage" which causes the toy to move up and down when in motion. The eccentricities



An off-center wheel under the "fuselage" of this new kiddy car in the form of an airplane gives the toy a realistic swooping up and down movement.

of the "monoplane" require a "training period" of ten or fifteen minutes, according to the inventor.

Red Paint Draws Barnacles

THE American merchant marine may save over \$100,000,000 as a result of the researches of Dr. J. Paul Vuscher of Western Reserve University, who has ascertained that it is possible to discourage barnacles from attaching themselves to the bottoms of ships by painting the undersides with a particular shade of light paint. A Government commission previously reported that the dark red paint usually employed was what really attracted the clinging crustaceans. Government chemists are now experimenting to develop a paint of the correct light-colored shade that will not be dissolved in sea water.

Safety Device Stops Trains

A NEW device that automatically stops trains when they pass a warning signal has been installed in Germany on the Berlin-Dresden line. The invention consists of a magnet affixed to the track at a point just past the signal tower, and an electric control mounted on the locomotive which it operates. Upon observing the warning signal, the engineer may throw a lever and disconnect the control, thus permitting the train to pass the signal at a slow speed. However, if for any reason the lever is not thrown, the train is stopped when it passes the point on the track where the magnet is placed. When this happens the train cannot proceed until the engineer gets off and operates a releasing mechanism attached to the signal tower. Neither ice, snow, nor water can affect the operation of the device, it is claimed.

New Poisons Kill Pests Only

GREATER deadliness to parasitic insects and kindred pests and less danger to human beings are claimed for two new spraying chemicals by Dr. Simon Marcovitch of the Tennessee Agricultural Experiment Station at Nashville. Sodium fluoride and sodium fluosilicate are the two new chemicals suggested as substitutes for the usual arsenic.



Motor-Driven Wire Stripper

INSULATION is cleanly and quickly removed from wire ends, making them ready for soldering or terminal connections, by merely inserting the pieces in this improved stripping machine and pressing the pedal. A productive speed ordinarily requiring eight persons is easily attained by this ingenious device, which does away with the tedious and time-wasting methods to which manufacturers formerly resorted.

Electrically driven rotating knives do the work. These may be simply adjusted so that the wire end is polished but never cut during the stripping process.

Biggest Phonograph Heard 30 Blocks

HERE is a talking machine that sends the strains of a popular melody thirty blocks with perfect ease and delivery! It is the champion in its line—the world's largest, strongest, and most distinctive phonograph.

Built on the roof of the Victor Talking Machine Company factory in Camden, N. J., it stands thirty-one and a half feet high, and is twenty feet eight inches wide and sixteen feet deep. To every detail it is a colossal replica of a popular model, even to the massive movable doors and screened grillwork.

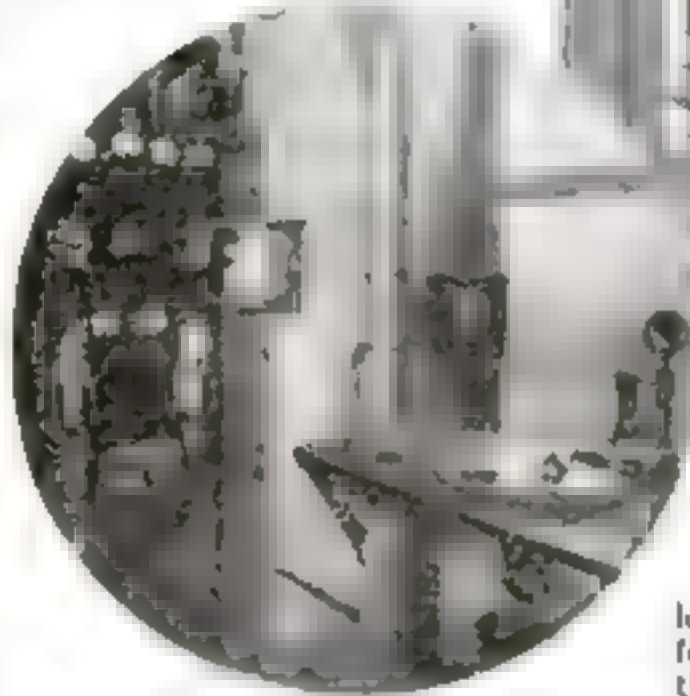
Standard records are played in a room

immediately beneath the model. Resulting tones are increased to their remarkable volume with the aid of a powerful vacuum tube amplifier which is connected in turn with the enormous sounding chamber in the huge phonograph.

So intense is the music that a person cannot remain in the cabinet for any length of time without suffering temporary deafness. Research workers actually became nauseated with a kind of sound sickness during the period in which the machine was tested.



The lady standing in it shows by comparison the size of this talking machine, 31½ feet high. At left in a room below a record is played. The sound is then amplified by vacuum tubes and sent to the instrument.



Stunt Flyer Takes No Chances

STUNT flying may be breath-taking but it certainly is not reckless deviltry, according to Gerhard Fieseler, German war veteran, who is the second man to perform a forward loop. The first to perform this hazardous feat was Lieut. J. H. Doolittle, U. S. Army pilot.

"For two weeks I plan every new stunt most carefully," explains Fieseler. "I consider every eventuality and leave nothing to chance. The machine may fail to pick up or the steering gear refuse to function, or some physical disability may overtake me in the midst of my stunt. All this must be studied beforehand."

Difficult stunts are practiced part by part until the flyer is master of each execution, and then only does he attempt the entire maneuver. Fieseler is also famous for flying upside down from Cologne to Bonn in fifteen minutes.

Nondrifting Mail Parachute

A MAIL parachute that does not open until it is within a few hundred yards of the ground is the invention of Arnold Wadlau, Swedish flying expert. When thrown overboard it drops folded for a considerable distance without offering much resistance to the wind, then a spring makes it start to unfold. The old style parachutes opened as soon as they were thrown out and often were blown far afield. With the new mechanically controlled type mail can be dropped close to a station.

Umbrella with a Window

PEDESTRIAN collisions and street crossing accidents due to the umbrella's obstructing vision would become less frequent if this German porthole idea were followed universally. A clear view is obtained through a mica window.

Decline of Railways Seen

MORE concrete roads, with fewer railways, are needed, because they are cheaper to construct, cheaper to maintain, and cost nothing for service, the National Roads and Motorists Association of New South Wales, Australia, has just told the government. Lieut. Gov. Sir William Cullen told the delegates "the time is rapidly approaching when provision for motor traffic will supersede making of railways. The progress of civilization is always toward simplicity."

Vaccine Given in Pills Now

A NEW and painless method of vaccination is being used in Europe with great success. The vaccine is taken in pills, chocolate covered. Prof. A. Beredka, of the Pasteur Institute in Paris, has developed this means of immunization, and declares it is much more rapid in its effect than the older system.

Extensive experiments in India, conducted by Lieut. Col. A. J. H. Russell, Director of Public Health in Madras, India, are said to have demonstrated the practical value of the new method.



A window of mica in this new German umbrella enables one to use it in severest weather and still see where one is going, thus avoiding collisions.

Smoke Dims City's Sun

NEW YORK CITY'S great smoke screen from factories, locomotives, and steamships cuts out forty-two percent of the morning sunlight that should bring warmth on winter days, say experts of the United States Public Health Service. At noon the loss is reduced to eighteen percent. The smoke not only dims the sunlight, but it also cuts off the sun's ultra violet rays, which are especially healthful.

Two Heads Proved to Beat One

THAT "two heads are better than one" at thinking out a problem is the conclusion drawn from experiments conducted among students at Columbia University by Prof. Goodwin B. Watson, who sought to test the familiar saying.

Four nine-letter words were selected, "educators," "neurotics," "secondary" and "universal." Twenty groups of students each working coöperatively were told to see how many words of three letters or more they could make in ten minutes from the letters in these words. Later each individual made words alone.

The average for a group was seventy-five words, while individuals attained only an average of thirty-two words, and the highest individual score was forty-nine words. This experiment, Prof. Watson says, indicates that speed picks up in group thinking. Further tests will be conducted to substantiate the theory.

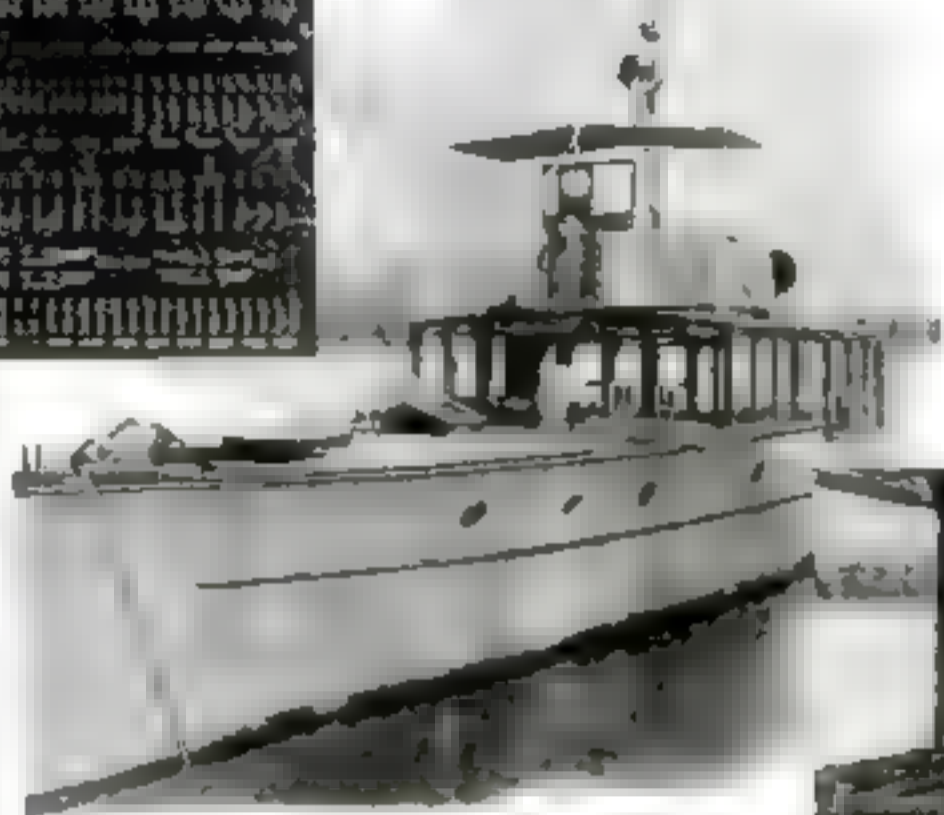
X-Ray Imparts Luminescence

THE latest power of the X-ray to be discovered is its property of making certain substances glow in the dark. Dr. Frances G. Wick, of Vassar College, reveals that the substances glow if first treated with the X-ray and then warmed. One such substance is ordinary gypsum mixed with manganese. This phenomenon is called thermoluminescence.

Electric Yacht Run | by Pressing Buttons



The great switchboard that controls the myriad devices of the electric yacht, operated by 36 motors and more than 4 miles of wiring



Right The \$83,000 sixty-two-foot yacht that goes faster than 25 miles an hour without a crew, all the work being done by electricity generated by three gas engines

THIS unique yacht, the Fan Kwei, is run throughout by a novel system of electrical control. Thirty-six motors, involving more than four miles of wire, enable Col. H. H. Rogers, its owner, to operate all driving, living, and recreational devices by pressing buttons or throwing switches. Only tossing the rope to the dock requires human

hands, and a mortar cannon device is being developed to do this.

If Col. Rogers wishes to leave the yacht he throws a switch on the elaborate switchboard shown in the top photograph, and a tender is mechanically lifted from the deck and lowered by the davits to the water.



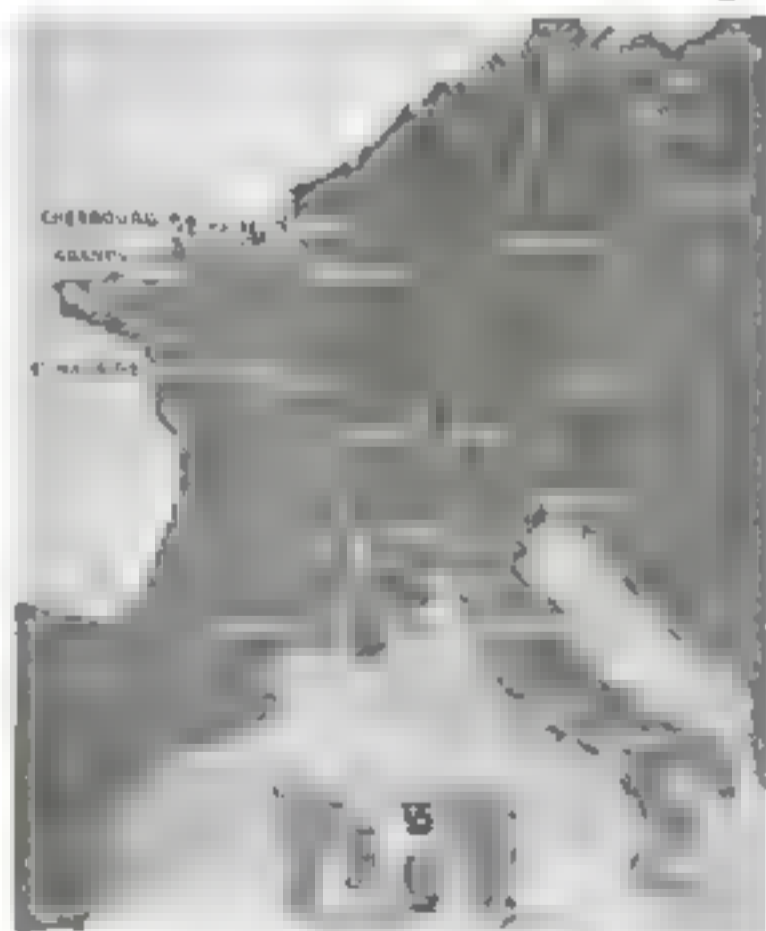
When a little music is wanted during tea or for a dance a button is pressed. A trapdoor rises and a mechanical device hoists out an electric piano. As the instrument starts playing the trapdoor sinks back to its place in the floor

Motor Super-Speedways to Cover Europe

SOON it will be possible for continental motorists to dash at forty miles an hour or more from the French channel ports or the Riviera across country to the Baltic without fear of arrest—unless they slacken speed! A gigantic system of auto speedways, already planned and mapped, will link France, Germany, Switzerland and Italy in a few years' time, if present plans proposed by an international conference of automobile clubs and backed by governmental authorities are fulfilled. Any speed from forty miles an hour upward will be permitted—and loiterers will be haled into court and charged with obstructing traffic!

Towns and villages will be skirted by the new super-highways, which, in accordance with France's recommendation, will probably be elevated above the ground and will have overhead railway crossings. They are expected to be a hundred feet or more in width.

Under the speedway system, motors will rival trains for high-speed travel. Future automobiles that use these roads,



Proposed network over western Europe of motor speedways, where cars will be streamlined, minimum speed being 40 miles an hour

it is predicted, will be completely streamlined and enclosed against wind—high-powered, and patterned after the low-bung cars of the race tracks.

Simple Color Film Invention

A LENS attachment for cameras that makes possible the photographing and reproducing of natural color motion pictures without special films or special developing solutions is the invention of Harold N. Cox, of Pittsburgh.

A cylindrical attachment is used on the lens front of any standard camera, and a similar device on the projector reproduces the colored movies.

In private demonstrations, according to reports, full colored rainbows, American flags, and vivid pictures of flower beds have been flashed on the screen.

Rubber Paving Defies Wear

RUBBER paving lasts longer under heavy traffic, reduces noise and prevents skidding, concludes the report of Col. T. H. Chapman, English engineer, on an experimental rubber pavement laid in London a year and a half ago. In that time it has carried 16,000 vehicles a day without appreciable deterioration.

Woman Manufactures Stone

A NEW process for making artificial stone was described recently to the Institute of Quarrying in England by Mrs. Ann Greaves, the only woman member. She declares she can produce this stone at a third the cost of real stone. It has the added advantage of being workable with hammer and chisel.

How to Start Your Garden Now

Plant in Boxes at Once, Plan and Fertilize Your Beds and You'll Be Ready for Spring

By E. BADR



Manure, the best fertilizer, should be dug in the depth of the spade and turned at intervals until it cools.

ARE you planning a garden this summer? Now is the time to commence making plans and even to start the early plants indoors, if you want a splendid melon patch or water bed to exhibit to admiring friends.

Your first operations will be to prepare the inside plant boxes, for there is still frost in the ground and the prospect of a few more chilly nights. Shallow wooden boxes, even cigar boxes or shallow pottery dishes are serviceable. Fill them with about two inches of light soil slightly moistened, and your "germinating vessels" are ready.

Now for the seeds—little brown grains that promise gorgeous blooms and luscious vegetables. You sprinkle them upon the soil and cover them with a layer of soil as thin as the seeds themselves. If they are fine, dustlike seeds they need no covering at all.

Away go the seed boxes to any frost-free room, where they will stay at an even, mild temperature. A dark room will do, for the plants need no light to germinate. Keep the soil just moderately moist and you will soon be rewarded by little green shoots sprouting all around.

WHEN transplanting time comes, one precaution may be necessary. You can take no liberties with certain types of plants, like cucumbers, melons, peppers and tomatoes; they resent the disturbing of their roots and do not recover from the shock in time to give an early, even crop. To humor them, it is best to use individual paper pots for the seedlings. The whole pot is transplanted without troubling the roots, and with the plant in its new home the paper jacket soon rots away.

Warmer weather has come now, and you are taking advantage of a bright Saturday afternoon to get the vegetable garden

ready. Clever fellow—you are making the rectangular beds just wide enough, so your arm can reach clear to the middle. When the weeds come, as they surely will, you can easily root them out. Your main path, I notice, is wide, that is good,



Cord around two stakes guides oval bed marker.

Folding the seedling's paper pot diagrammed below. The upper corners of the sheet are folded against each other on the diagonal dotted lines then against right and left rectangles, which form sides. Lower corners are folded in same way and tabs folded over to fasten box together.



for it means that you can walk in comfort through the garden.

When it comes to the flower garden in your front yard, you must turn landscape gardener and use discretion, particularly if space is restricted. You will remember that a small front yard is most pleasing with a lawn, your flower display will then be one or two formal beds, perhaps circles, squares, ovals or half-moons. Around the house you can place additional flowers without cutting up your lawn, to give a brilliant array of color. Here the little marigolds and bachelor's buttons are at the front, with the tall hollyhocks or sunflowers in back.

When you have more of a yard to work with, you can flank your center walk with several formal beds of the same size and shape. If the walk is at the side, you can let your fancy run free.

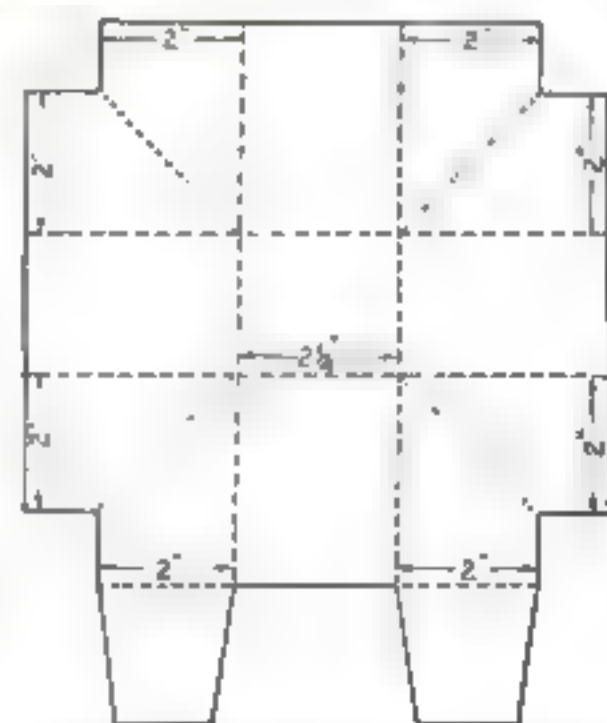
To lay out a circular bed, sink a stick in the center, tie a cord to it and tie another stick at the end of the cord to draw the

border line. It is always a good plan to dig up a few inches of soil around the edge of the bed on the line you have drawn, this raises the bed and lowers the walk around it a trifle. For an oval bed two stakes are driven and a cord placed around them and a third stick, which is used as the marker. (See center photograph.)

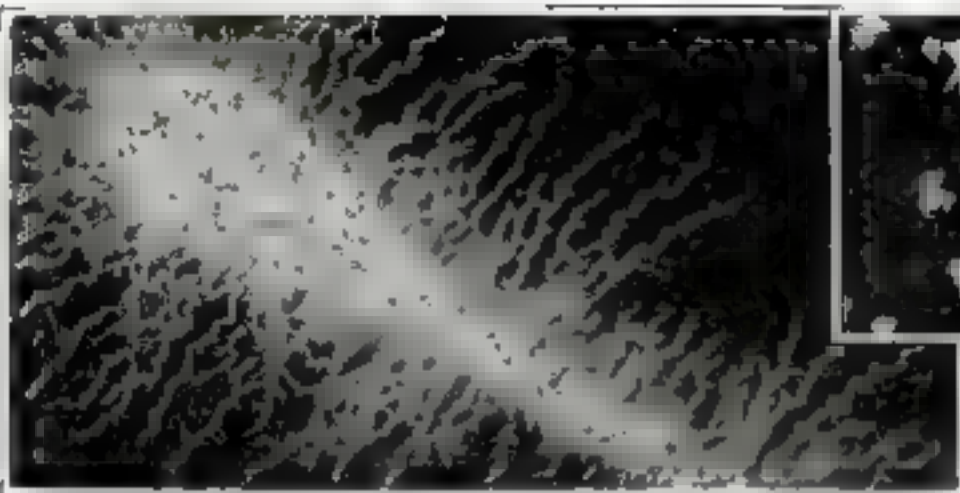
You have dug up the bed, fertilized it, smoothed it, planted the seeds in little rills and tapped earth gently over them. Now a few days have passed, and the plants are growing splendidly. Soon they will need thinning, if your work has been well done.

HOW about fertilizers? Soil should be enriched when it is first commanded to make a garden. Meadow or forest land usually requires only lime sprinkled over it a few weeks before seeds are planted to counteract the natural acidity of its decaying organic matter.

Cultivated ground requires substances rich in phosphates, lime, ammonium and potassium salts, such as manure and artificial fertilizers. Whenever possible, manure is used, spread and dug in to the full depth of the spade. Turn it every other day for a week, then two or three times at weekly intervals; this cools it. Then you can start planting.



Diagram, looking at the inside, is seedling paper pot before folding on the dotted lines. Center rectangle is the bottom, four others, the sides.



Footprints of a fly photographed and highly magnified by the ultra-rapid lens. In each print are innumerable spores, microscopic plant organisms formed by the decay of food particles either up to 1/16 of an inch. The picture above was taken immediately after the footprints were made. The one at the left was taken later and shows the spores sprouting out and growing.

Deadly Gardens in Fly Footprints

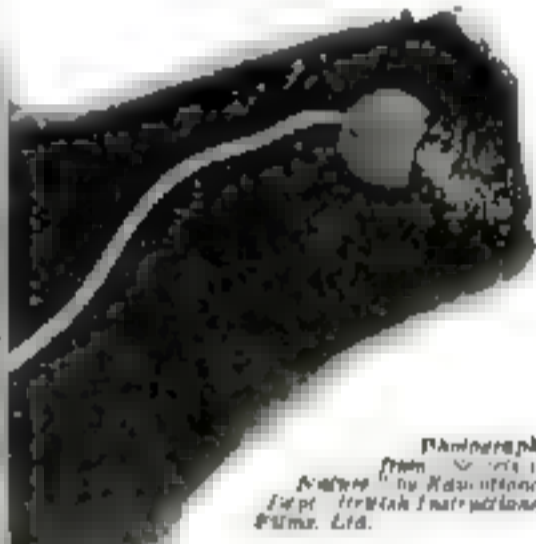
Amazing Films Show How Decaying Matter That Spreads Disease Sprouts, Grows and Multiplies In Every Track Left by Insect Pest



When two plants growing from the roid, or decaying matter, picked up and later dropped by the fly's feet, come in contact with each other, they form what scientists call a "plant marriage," which results in a comparatively gigantic ball of spores—although it too is so small that it can be seen only with a microscope. From this ball sprout more plants, adding greater intricacy to the fly's "garden" in the fly footprint.

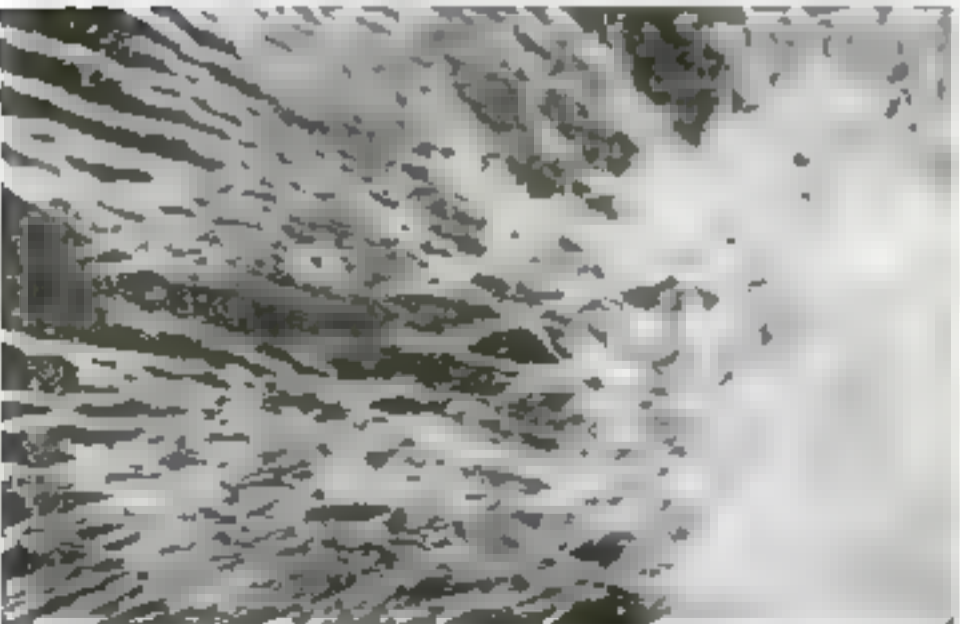


A much more highly magnified photograph of a plant marriage. When the mold plants approach each other they react by sending out special growths reaching toward each other. When they actually meet the formation of the ball of spores results. This remarkable photograph shows the special growths in various stages of approach and in the middle two of them are seen almost at the point of meeting.



Photographs from the series of Nature's Educational Dept. (British Instructional Films, Ltd.)

One of the plants that grow out of the marriage. These plants grow with extreme rapidity and bear a kind of "fruit" that ripens and sends forth more spores, which in turn develop into plants of larger size and continue the chain of reproduction.



This highly magnified photograph shows the growth of mold from cheese in one of the tiny fly footprints seen in the photograph to the right at the top of this page. This strange process of growth in decaying animal and vegetable matter is one of the most malignant causes of disease, and these photographs show what able and dangerous allies flies are in the deadly work, picking up and distributing the decaying matter wherever they go.



The cheese mold "garden" in a fly's footprint when it has reached its maximum growth. The white area toward the right is the spot of greatest development of the spores into plants. Although this growth process, which is also a process of decay, is all in accord with Nature's laws, it still constitutes a menace to human life, hence the need of constant vigilance to exterminate flies as the most industrious carriers of spores that breed disease.



Location has much to do with tuning problems; selectivity is particularly important in the city. In the country you want ability to bring in stations perhaps hundreds of miles away.

Tips to Help Get Sharp Tuning

How to Increase Selectivity by Good Antenna and Ground · Biasing Radio-Frequency Tubes · What a Wave Trap Will Do

By JOHN CARR

TUNING IN the radio station you want is a lot like picking the apple that appeals to you from a dish on the table. But how are you going to pick out one particular apple if the dish happens to be filled with apple sauce?

And that, in many cases, is precisely the situation that confronts you when you attempt to tune in a particular broadcasting station from among a number of others.

You reach into a dish of radio apple sauce—stations all jumbled together on the same wave length—and you fish out part of the broadcasting you want plus a collection of squeals, howls and garbled bits from the other stations that happen to be broadcasting on practically the same wave length.

The sharpest-tuning radio set in the world wouldn't help you a bit in a case like that. You could tune it till you wore out the controls without getting rid of the interfering stations.

Before you condemn your radio receiver for broad tuning be sure, therefore, that the receiver really is to blame and that you are not requiring it to do the impossible.

Location, too, has much to do with what you can or cannot accomplish in the way of improving the tuning qualities of your receiver. If, for instance, you are located in a city surrounded by many good broadcasting stations and consequently care nothing

about bringing in distant stations, you can afford to sacrifice sensitiveness for additional selectivity.

If on the other hand you live a long distance from the nearest broadcasting station you naturally won't want to do anything that will cause the stations to sound weaker. Fortunately, however, if you are a long way from the stations you do not need the degree of selectivity required by the city man.

DISTANCE makes the tuning sharper, so that a set that wouldn't choose between stations when used in the city

might be perfectly satisfactory in the country.

The antenna and ground system on any radio receiver have considerable to do with its real and apparent selectivity. The lower the resistance of the antenna and ground to radio-frequency currents, the sharper will be the tuning. Anything you can do to cut down the resistance will, therefore, improve the selectivity. Poor insulation and suspending the antenna too near to large masses of metal cause an increase in the radio-frequency resistance.

Suppose your antenna is fitted with cheap leaky insulators and runs for many feet quite close to a metal roof. Replacing the cheap insulators with more efficient ones and moving the antenna away from the roof will make it easier to choose between stations and make them louder as well.

However, a good antenna is not much better than a poor antenna unless you have a good ground connection.

Do not be satisfied merely to connect the ground wire to the most convenient point on a water pipe and let it go at that. Experiment a bit. Try running a wire straight down into the cellar and ground it on the water pipe at the point where it enters the house. Run another ground wire to the galvanized or copper drain pipe that carries off the rain water from the roof. In fact, it is a wise plan to ground your radio set to every large mass of metal in the immediate neighborhood. Some of these grounds may not do any apparent good, but it is well to try

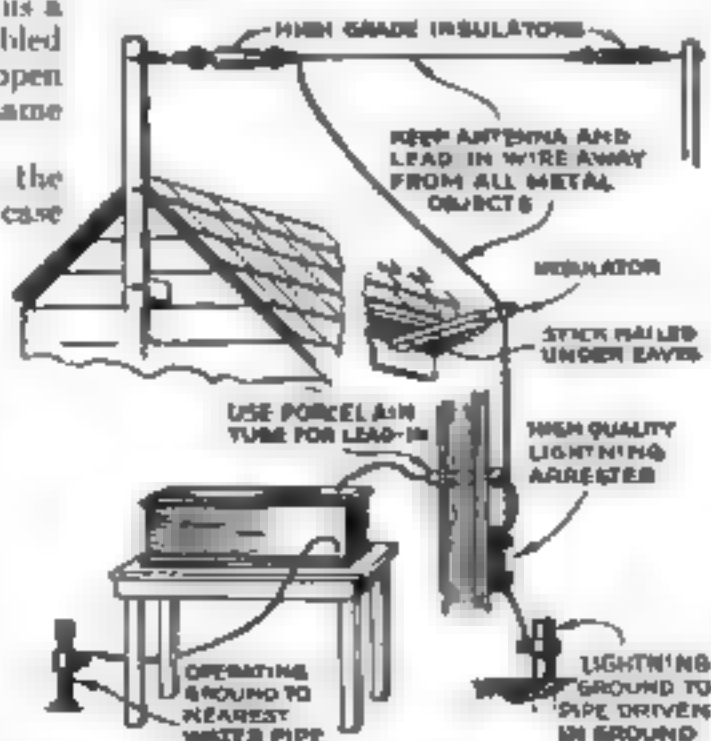


Fig. 1. You can improve selectivity of any radio installation by careful attention to aerial and ground.

them if only to assure yourself that you have the best ground possible in your locality.

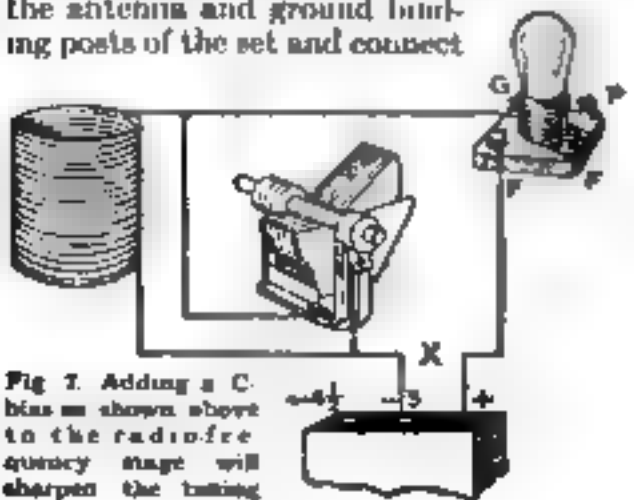
If you are located in a house where there is no running water supply and if to make matters worse, the house is built on dry, sandy soil, then you will have to resort to special means to obtain a good ground. One of the most satisfactory ways is to bury a bare copper wire in a circle about your house and run leads from four or five points on the circle to the center, where they should be soldered to the wire that leads to the ground binding post of your receiver. All points should be soldered and the wires leading to the circumference of the circle should be buried under the surface of the ground. Installing a ground system of this type is a back-breaking job and should be undertaken only as a last resort.

Apparent selectivity is obtained by cutting down the length of the antenna, but you lose signal strength by this method. Connecting a fixed condenser of very small value in series with the antenna accomplishes about the same result as cutting down the length of the antenna.

THE stages of radio-frequency amplification have much to do with the selectivity of a receiver. Poor coils, poor condensers and improperly placed shielding have some effect in spoiling your chances to choose between stations, but poor control systems are responsible for most of the trouble. This is particularly true of many older sets built in the days when a potentiometer was used to prevent the radio-frequency stages from oscillating. As an oscillation or "squeal" control the potentiometer is a foolproof system, but if you use the potentiometer as a volume control as well, you are bound to broaden out the tuning on all the local stations—where the need for selectivity is greatest.

If you have a set of this type, you can greatly improve the sharpness of tuning by installing a separate volume control so that the potentiometer can be used only to control oscillation. Then if you set the potentiometer so that the vacuum tubes are close to the oscillation or squeal point and control volume independently, you will improve the selectivity to a very marked extent.

THE ideal place to control the signal strength is at the point where it enters the receiver. This is the method employed in the POPULAR SCIENCE electric set, and the same method can be used with any radio receiver. Purchase a 500,000-ohm potentiometer of the non-metallic and noninductive variety. Connect the outside terminals to the antenna and ground binding posts of the set and connect



the antenna to the center tap on the potentiometer.

The reason the potentiometer causes broad tuning when you attempt to use it as a volume control as well as a "squeal" control is because the cutting down of the volume is attained by making the grids of the tubes positive, whereas they should be negative for best selectivity.

In receivers using other methods of "squeal" control, you can take advantage of the increased selectivity when the radio-frequency tubes are operated with the filaments slightly negative by applying a one and a half to three-volt C-battery to the radio-frequency stages of amplification.

The way to do this is shown in Fig. 2. You will find that in the radio-frequency stages of any type of receiver each stage has a tuning coil and a variable condenser. The fixed plate terminal of the variable condenser always is connected to one end of the tuning coil and to the grid terminal of the tube socket. The other end of the coil always is connected to the rotary plate terminal of the condenser. Sometimes there is a branch wire that can be traced from the rotary plate terminal of the condenser to some point on the filament wiring. If there is, cut the wire and connect in a C-battery as

This Booklet Will Help You

IF YOU expect to buy, install and operate radio receiving equipment, send for the twenty-page booklet "What Radio Buyers Should Know," dealing with these problems. It includes a list of tested and approved radio equipment. The price is twenty-five cents. Send your orders to the Popular Science Institute, 250 Fourth Avenue, New York.

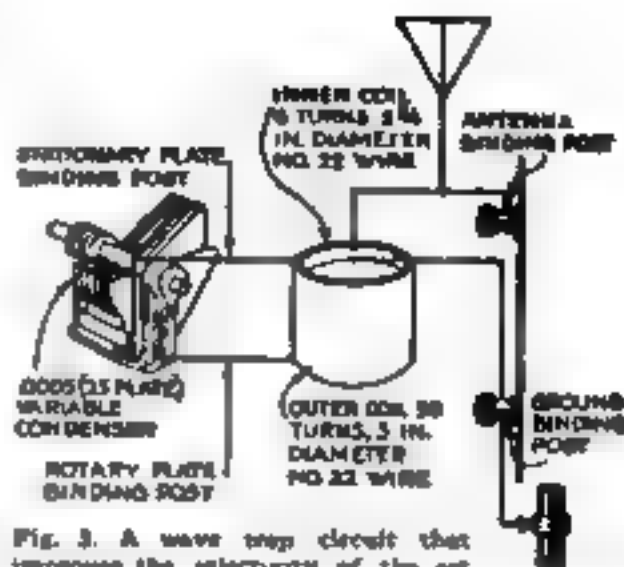
indicated in Fig. 2. This cannot be done if the set has a metal panel in such cases the grid return is by way of the metal panel and perhaps part of the metal chassis.

Of course a C-battery can be applied to the radio-frequency stages of such a set, but the method depends on the way in which the filament circuit is worked out and is different with each particular receiver.

Fig. 2 also will help you to make another change in your receiver that will, in many cases, improve selectivity and also the tone quality. It is a change, however, that will materially cut down the sensitiveness of the receiver to weak signals and so is of no advantage if you want to bring in distant stations.

This change is to substitute a C-battery for the grid condenser and grid leak on the detector tube. With grid bias detection instead of grid condenser detection, the tube also will handle louder signals without distortion. This feature is of relatively little importance in most cases, however, because severe distortion usually occurs in the audio amplifier before the detector tube becomes overloaded.

Look over Fig. 2 and you will note a continuous wire running from the upper end of the coil to the grid terminal of the



tube socket. In the radio-frequency stages this wire is continuous, but in the detector stage it always includes a grid condenser with a grid leak connected in parallel with it. To install grid bias detection, this grid leak and condenser must be removed. The simplest way to do it is to wrap tin foil around the grid leak and put it back in the clips. The tin foil short-circuits both the grid condenser and grid leak and gives the same effect as a plain piece of wire between the two points.

The C-battery is connected in as shown in Fig. 2, except that for the detector circuit, four and a half volts should be used, instead of three as shown.

Many types of wave trap circuits have been designed to improve the selectivity of a radio receiver. One of the simplest and most effective is shown in Fig. 3. It will give you as much added selectivity as another stage of radio-frequency amplification, whether you add it to a simple one-tube set or to a large receiver that already includes two stages of radio-frequency amplification. Of course, this wave trap circuit does not increase the volume, but if you buy a high grade coil or carefully wind one and you use a high grade condenser you will find that there will be no appreciable falling off in signal strength.

NEITHER the diameters of the coils nor the capacity of the variable condenser need conform to the specifications given in Fig. 3. The condenser has to be of the correct capacity to work with the larger coil in order that the circuit will operate over the broadcast band of wave lengths.

It is entirely practical to purchase the coils. You will note that the diameter and number of turns correspond to the specifications of many factory-wound coils that are sold for use in various tuned radio-frequency circuits. If you don't care to wind the coil yourself, take this magazine with you when you go to the radio dealer and he will be glad to pick out for you a stock coil and a condenser that will work with it.

If you have a condenser on hand that you wish to use that is not of .0005 mfd. capacity (twenty-three plate), you can alter the number of turns on the large coil to fit your condenser. If your condenser has a capacity of .00035 (seventeen-plate), wind the larger coil with sixty turns of wire instead of the number specified in Fig. 3. With a .00025 mfd. (eleven to thirteen plate) condenser use seventy-two turns of wire.

Fine Points to Help You in Radio

Difficulties of Wiring Simplified

Prolonging Life of Tubes by Correct Voltage—Testing Condensers

WHILE a firmly soldered joint is ideal in electric wiring, there are cases in radio where soldering is not so convenient.

For example, you may wish to connect wires to an instrument that is equipped with binding posts instead of lugs. The simplest way is to wind the bared ends of the wires around the binding posts and screw down the nuts, but it is very difficult to do a good, solid job that way.

A satisfactory way is to solder a lug to the end of each wire and then clamp the lugs under the binding post nuts. In the illustrations on this page is shown a way to form lugs on the ends of the stranded insulated wire now so popular for radio hook-ups. This method gives a strong lug that will not become detached from the end of the wire.

As shown somewhat enlarged in Fig. 2, the procedure is simple. The end of the stranded wire is bared and the strands divided into two groups. These groups of strands are wound around a special eyelet in opposite directions as shown in the center of Fig. 2, and then the eyelet is compressed in the special pliers shown in Fig. 1. The result is a perfectly formed lug, as shown at the right in Fig. 2.

When several binding posts have to be connected to the same wire, this eyelet-lug arrangement is ideal, because the wire can be bared at the point corresponding to the locations of the binding posts, the strands divided, and a lug clamped in place without cutting the wire.

T-connections also are easily made by removing the insulation from the point on the wire where the T is to join, spreading the strands, and then twisting the strands from the branch wire around the same eyelet before clamping.

It is not necessary to solder these connections at all, as the clamping gives a positive connection.

Use the Correct Voltage

THE importance of using the correct A, B and C voltages on a vacuum tube can hardly be emphasized too much.

The A-voltage is the voltage applied to the filament of the tube. It may be direct current in the case of storage battery type tubes or alternating current in the case of the new A C tubes. The same rules apply in both cases. Operating the tube with the A-voltage more than a very small fraction above the rated voltage will shorten the life of the tube by many months in most cases. Operating it at below normal voltage will result in poor tone quality if the tube is used as an audio amplifier or



Fig. 1 When the eyelet is placed between the jaws of the pliers, the tubular portion is curled outward and pressed against the strands of wire, making a solid connection.

A B C's of Radio

HOW long should a vacuum tube last? One thousand hours, nominally. Actually, the life of a vacuum tube depends on how it is used. Turning the rheostats too far, so that the tubes burn too brightly may cause them to give out after only a few hours of service. Too low a C-voltage may cause them to stop functioning long before their appointed time. No two vacuum tubes are exactly alike. They may have been manufactured with the same tools and out of the same materials—yet one may last longer than the other.

How often should I replace the vacuum tubes? The answer to this must also be qualified. A vacuum tube should be replaced when it no longer functions as it should, but if you have no way of testing the tube, all you can do is to have a spare tube of each variety always on hand and every two months substitute the spare tube for each one of the same kind in the set. If a spare tube improves results, the one it replaced should be discarded. If no improvement is noted, put the old tube back.



Fig. 2 At left—Eyelet between parted strands of wire. Center—How the strands should be curled around the tubular portion of the eyelet. Right—The perfect lug formed by the special tool pictured in the top illustration.

weak volume if it is performing the function of a radio-frequency amplifier.

The B-voltage can be less than maximum, if desired, but of course the volume will be less. For instance, if the 171-type tube is operated at 150 volts instead of 180 there will be a noticeable decrease in volume.

Applying the proper C-voltage is where most radio fans make mistakes. The proper C-voltage depends entirely on the B-voltage, and if the tube is operated with lower than maximum B-voltage the C-voltage should be cut down, otherwise tone quality suffers. Unfortunately, however, the tone quality you obtain does not indicate whether the C-voltage is right. You can cut the C-voltage down far below the proper value, and the signals may still sound all right, although the tube may be badly overloaded. If you have no reliable means of measuring the plate current of the tube and, as is often the case when you are using a B-eliminator, you don't know what the B-voltage actually is, play safe with the C-voltage and run it up as high as you can without spoiling the tone quality. You may not get just the right combination for maximum power by this procedure, but you will insure long life for the tubes.

Testing High Capacity Condensers

A VERY common method of testing connections to see if they are tight and to test wires for broken points is to use a test circuit consisting of an ordinary drop cord with a fifteen-watt lamp in the socket. One of the two wires of the drop cord is cut. If the two bared ends are brought together the current will flow and the lamp will light. It follows that if you touch the two bared ends to each side of a doubtful connection and the lamp lights, you can be sure that current is flowing through the doubtful connection. Commercially built test sets embodying this idea are for sale. Such an outfit, either home or factory built, is very useful in testing for broken connections and for short circuits.

However, there is one test where you are liable to be badly fooled. If the test circuit is operated by alternating current you may find that the lamp lights when you connect the test points to the terminals of large capacity condensers such as are used in filter circuits. This does not mean that the condenser is short circuited. A large condenser with a capacity of several microfarads will pass enough current to light the lamp almost to full brilliance. A large capacity condenser can be tested for a short circuit only by the use of direct current.

A House Has Its Face Lifted

How the Old Everett Home Lost That Pinched Look by a Sweeping Change in Its Roof Lines

By JOHN R. McMAHON

"FINEST suburb in America, boys!" proudly announced a substantial citizen among a group assembled on the sidewalk to view a local celebration.

"It would be if it wasn't for one thing," agreed a tall neighbor with a deep voice who was standing near by.

"What's that, Dan?" asked the first speaker.

"Why, the fossils who hold up architectural progress by keeping their old houses."

"Some of the owners can't afford to improve," suggested a ruddy bystander, charging his briar pipe.

"Can't, eh?" retorted Dan. "I happen to know of one with a bank account equal to yours and none put together. Yet he keeps living in the common old frame shack he bought when he came here."

"What's his name?"

"Everett."

"Yes, that's a case of —" someone began.

"Excuse me, gentlemen, my name is Everett," interrupted a mild voice in the rear.

There was a confused murmur of apology mingled with embarrassed laughter.

"THAT'S all right, I don't mind a few neighborly knocks," said Mr. Everett good-humoredly. "Just thought I'd speak up for myself. I like choice materials and good appearance as much as anybody. They are within my means. But my chief trouble is location. I have an ideal site in a quiet street with many shade trees. It would be practically impossible to find a site as good. Now I might tear down the old house and build a new one, but there are objections, including the size of the lot and the contrast that a swanky new house would make with our immediate neighbors. Again, I am not very ambitious at my time of life, with the children growing up and leaving, about having a stylish new residence."

"There is something in that point too," agreed an auditor.

"Of course all this," resumed Mr. Everett, "does not justify utter neglect of my 'common old frame shack,' as it was called. Well, I have not neglected the house. It has been twice improved internally and it has everything inside that is needed for neat and comfortable

THIS is the second of Mr. McMahon's series of articles telling of the experiences of real people in building and rebuilding houses. Perhaps you or your friends have had interesting problems which Mr. McMahon can discuss in one of his future articles. If so, write a letter telling about them to the Home Building Dept., POPULAR SCIENCE MONTHLY, 250 Fourth Ave., New York.



Above the Everett house today was at the right as it appeared before alterations. See how the tuckering effect of the old roof line has been changed by the change to the new roof line. The new roof line is a better example of the effect of the new roof line. The new roof line is a better example of the effect of the new roof line. The new roof line is a better example of the effect of the new roof line.



living. The outside has bothered me, as well as my friend Dan. The answer is that the outside will be tinkered shortly so as to make a new and better front. An architect is studying on the plans right now. When we get through I hope that my house will have a respectable if modest place among the residences that adorn this town."

It was some months later that I visited the architect in this case, H. Messenger Fisher, and asked him to tell me the details. He was willing to do so provided the client's desire to avoid mention of his name was respected. That was an easy condition. I am sure no reader who is interested in house changes minds that the owner's name is also changed.

"Are more houses being altered today than formerly?" was my first general question.

"Yes," replied the architect. "The increased cost of building is a leading factor. If you can fix up an old house at one quarter to one third the cost of a new one, you will be inclined to do it. People are now more sensitive to looks and have

changes made on artistic grounds alone. Others combine the demand for better looks with practical improvement. New inventions and discoveries stimulate change; for example, oil burners, wall-board, brushing lacquer and violet-ray glass. These things add space, speed up alteration or put the benefit of the latest discovery within reach of any householder."

"HOW old is the Everett house?"

"About twenty years, and this is the third time it has been tinkered up," replied Mr. Fisher. "The first alteration consisted of a sleeping porch sun room added in the rear off a bedroom. Some years ago I put a similar addition of sleeping porch sun room on the south side of the house. Nothing had been done about the general architectural lines of the original dwelling and I was not surprised when the owner came to me recently and said

"My house has a narrow look. What can I do to make it look wider?"

"I replied to his question: 'The roof is the key to this problem, as it is in many other cases. It is the most conspicuous part of a house and may

either enhance or detract from the general appearance. The present roof is like a small hat on a big man. We can increase it to a dignified size while taking advantage of broadening lines and at the same time incorporating interior improvements. The front view effect of the present roof is a small triangle with crowded space below. We could make a large triangle, if necessary, but your requirements and the appearance will be satisfied by extending the triangle line on one side.'"

"OF COURSE you went into more detail," I suggested.

"Yes," said the architect. "The specific recipe was like this: The main roof wing a hip, bring the ridge to the plane of the

front wall, making a gable. Continue the south gable line to the top of the sun room, which will increase the front wall space of the second floor. This will make the house look wider. The present front with its bay window and hip roof is lacking in the contrasting element of wall surface. We will gain the latter and get rid of the crowded effects. Horizontal lines tend to give a wider appearance and in the same way vertical lines make a house seem tall or narrow."

"What do you mean by lines, architecturally speaking?"

"Anything that the eye notices as such. Paint may give the desired effect, but the eye is better convinced by structural lines, as of roof, walls, doors and windows. Now, the old hip roof of the Everett house had a dormer with four windows in a row. I saw that we could use these windows in the new gable; and, by adding two more windows, one on each side, we would gain more of the horizontal line broadening effect. And while the extra windows improved the exterior aspect, they benefited the enlarged attic bedroom with more light. This improved bedroom was to be used as a guest chamber with a small room near by turned into a bathroom."

"Did you have everything figured out in advance?"

"No, and it doesn't usually happen that way, especially with a remodeling job," said Mr. Fisher. "The owner first talks it over with the architect. Then the architect looks over the scene, studies the plans and makes preliminary sketches. Everybody concerned talks a lot more. The sketches are revised and approved. The plans are drawn to scale and a contract is made with a builder. Then when the work is started the owner has a new idea, and we may have to change a number of things. One of these ideas in this case had to do with the question of connecting rooms. The original house had three interconnecting rooms, used by parents and children for sleeping quarters. As children grow up, more privacy is required. Therefore the extra doors between these rooms were removed and the spaces were filled up."

"There is no difficulty in shifting doors and windows, I believe."

"USUALLY not with frame construction. To close an opening, remove trim, insert two-by-four-inch studs spaced on sixteen-inch centers, cover both sides to match wall surfaces, and there you are. To make an opening the wall material must be sawed out, and studs doubled at the sides and top of the opening. A truss may be needed at the top if the span is wide and the partition carries much weight. Then the trim goes on, and the new door or window is fitted in. It costs a little more in material and labor to add than to subtract an opening."



THE NEW ATTIC FLOOR PLAN, showing enlargement of the bedroom, increased window space, and a new bathroom



A view of the remodeled house on the south side. Notice how the house has been widened and its appearance improved by the addition of the sleeping porch on the second floor above first floor sun room

wall. Sometimes a soil pipe is hidden by making a partition wider than usual with studs two by six instead of two by four inch. There is another occasional problem—to avoid showing the exposed top of soil pipe upon a front roof. The answer is to carry the soil pipe between the attic rafters to the rear and let the exposed part project from a back roof. This method is generally allowed by the plumbing codes. But it is necessary to specify such a detail in a contract and to see that it is observed, since the average plumber will overlook it. Of course it takes more time and material to run pipe at an angle through the attic instead of vertically."

"How much old material is salvaged on a job like this?" I asked.

"That depends on circumstances, including the cost of new stuff. In this case some of the original

"A change in plumbing in an old house is likely to be troublesome," I suggested.

"Yes, as in a new bathroom in an attic," replied the architect. "People say, 'I want a new bathroom here,' and they never think that there may be a problem to connect the soil pipe down through the house to the old drain line in the cellar. In this case the location was fortunate, since the soil pipe from the attic fixtures went through a second floor closet and then through the kitchen, where it could be boxed alongside a

rafters were used to frame the new roof and the original attic windows stayed to keep company with the new ones. When a chimney is torn down the old bricks can be cleaned and used again for rough masonry or backing for face brick. The economy of salvage depends largely on labor cost and also on quality and condition of the old material. It does not pay to save cheap or damaged stuff like warped shingles, weathered siding, rusty tin and galvanized iron. It might be well for the owner to ask for two bids, one based on salvage and the other on all new stuff. If the difference is slight, take the new material."

"THERE is real economy in standard-size doors and windows."

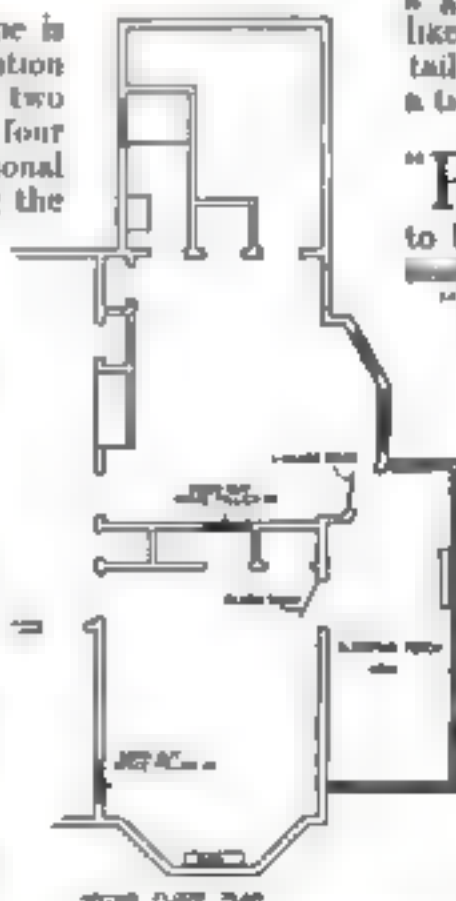
"Certainly," agreed the architect, "whether on a new house or an alteration job. It is the same as buying ready-made shoes versus made-to-order footwear. There is a wide range of stock sizes that will fit practically every need, and you save time as well as money. Even an

architect sometimes overlooks this point in some detail. I did myself on the Everett house when I specified a pair of eighteen-light glass doors for the new sleeping porch on the second floor. The carpenter reminded me that this was a special size and that fifteen-light doors, being stock, would cost less. No one would ever notice the trifling difference between the two sets of doors, and I readily gave permission for the change. Of course the owner is credited with such an economy when it develops after the contract is signed for the work to be done at a given figure. If the change in plans is made before the contract is signed, the contractor presumably lowers his bid accordingly. There is not a great saving on one detail like that, but a number of detail economies may add up to a tidy sum."

"PLASTERING rooms in an occupied house used to be quite a bugbear," I reminded.

"It was and is, but has now become unnecessary, thanks to new materials and methods," said Mr. Fisher. "The first invention toward abating this nuisance was the development of wall-board, sections of material four feet wide and the height of any room, that could be nailed direct to studding. Thus we got rid of lath and quantities of wet plaster. The job was dry, clean and speedy. Of course the joints between sections had to be filled with a plastic substance. The question of finish then arose.

(Continued on page 130)



In the remodeled second floor three interconnecting rooms were separated by removing the doors and filling in the spaces as shown. A new sleeping porch was added

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Unmasking Garage "Gyps"

How to Save the \$20.66 You Waste Yearly on Useless Auto Repairs and Poor Workmanship

By
MYRON
M. STEARNS



The owner kicked like a steer at a \$7.15 bill when the job took only two minutes.

A SHORT time ago the following letter came to the editor of POPULAR SCIENCE MONTHLY:

"Dear Sir:
"What is the matter with our garage men?"

"Last week I took my car to a garage, and left word what I thought the trouble might be. When I went to get it they told me the trouble had evidently been what I had intimated, and that they had fixed it. The bill amounted to only \$3.45, but on looking it over I found they had replaced a part that had been put in new only a short time before, and which I knew was working perfectly. The car ran no better than it had before. The real trouble had not been touched.

"Do these things happen because the garage men are trying to get out of their business more than there is in it, or is it a case of being plain dumb?"

"Sincerely yours,

"Carl Granquist,

"Rockford, Ill."

The editor turned that letter over to me. "Three dollars and forty-five cents," he said, "is no great matter. But nearly everybody has had that same experience in one way or another. Let's learn the truth about it. What are the chances, when a man takes his car to a garage for repairs, that he'll get an honest, efficient job? See if you can't get the facts."

I found out that there are approximately 50,000 garages in the United States today doing repair work, and that something like \$1,000,000,000 a year is spent in them on such work. But the startling thing is this: Inquiries among garage men, repair shops, automobile owners and mechanics led me to believe something like half the total is wasted!

Five hundred million dollars a year wasted on unnecessary motor repairs and inefficient work, or worse!

At that I found nothing to indicate that garage men or repair shop men as a whole are naturally any less honest or well meaning than men in other occupations. The average garage owner feels that he is running a perfectly honest business, competently and efficiently. I found car owners as a rule slow to criticize, and usually quite loyal to their particular repair men—just as people are to a doctor—but I got, bit by bit, the real facts behind this huge waste. Finally I went to one mechanic I've known for a couple of years, a veteran and an expert. We sat outside his garage, twenty miles outside of New York City on the Boston Post Road, went over the information I had obtained, and outlined the main causes of the tremendous waste in motor repairing.

THE table we worked out, on the basis of what the losses of \$500,000,000 a year cost the average owner of one of the 23,000,000 cars in the United States, subdivided the losses under five heads:

Bad diagnosis, \$1.04.
Bad management, \$8.98.
Bad judgment, \$3.26.
Bad workmanship, \$3.20.
Bad faith, \$2.02.

And here is what Fred Gartner, as I shall call him, told me with specific illustrations of each of the different kinds of waste, gleaned from his long experience in auto repair shops:

"One of the biggest losses comes from not being able to locate the trouble. Any mechanic who is a good diagnostician, who can tell by the sound just what the trouble probably is, is worth big

wages. They all think they can, but if we say one mechanic in five is a good trouble shooter we're being liberal.

"Once I was working in a garage outside Guendora, in Southern California, when a man walked into the shop.

"'Have you got a good carburetor man here?' he asked. 'I've got a car stuck down the road here, and I think the trouble is in the carburetor.'

"'Jim, here,' says the boss, 'is our carburetor man. He invents carburetors.' Like a lot of garage proprietors, the boss was a great kiddier but didn't know an awful lot about machines himself. Jim was hardly more than an apprentice. He goes out with the man, and after an hour comes back. He hasn't been able to get the car started, so we tow it in.

"BY THIS time Jim has decided the trouble is with the piston. He scrapes all the spark plugs and goes over the wiring. No result, so Jim decides it's the timing and gets after the distributor. There goes another hour. Finally, when they can't get the motor to show a sign of life, Jim opens up the gasoline tank and smells the gas.

"'There's your trouble,' he says, 'Smell that! That stuff they've sold you wouldn't fire in a tractor!'

"They crank out about seven gallons of the stuff and put in new gas. 'Now you're O. K.,' says Jim.

"The owner gets in and steps on the starter. Nothing doing.

"Now it's almost quitting time and they call me over to see if I can help out. The owner thinks there's dirt stuck in the needle valve of the carburetor.

"'It's possible you're right,' I said, 'although that's a mighty unusual thing to have happen. (Continued on page 152)

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Useful Kinks for the Motorist

Double Purpose Light Switch and Other New Ideas

MODERN automobiles are built so close to the ground that it is no longer easy to crawl underneath them to do any necessary repair work. Of course, it is easy enough to jack up either the front or rear wheels to make it easier to work under the car but there always is the possibility that the jack mechanism will break or that the car will roll off the jack in response to a sudden pull with a wrench or other tool applied to some part of the chassis. Wooden blocks made up as shown in Fig. 1 will eliminate both these possibilities and also save time. It is desirable to hinge the tapering ends so that they can be swung around out of the way after the car has been run up on the blocks. This arrangement will give you more room and make it easier to move around

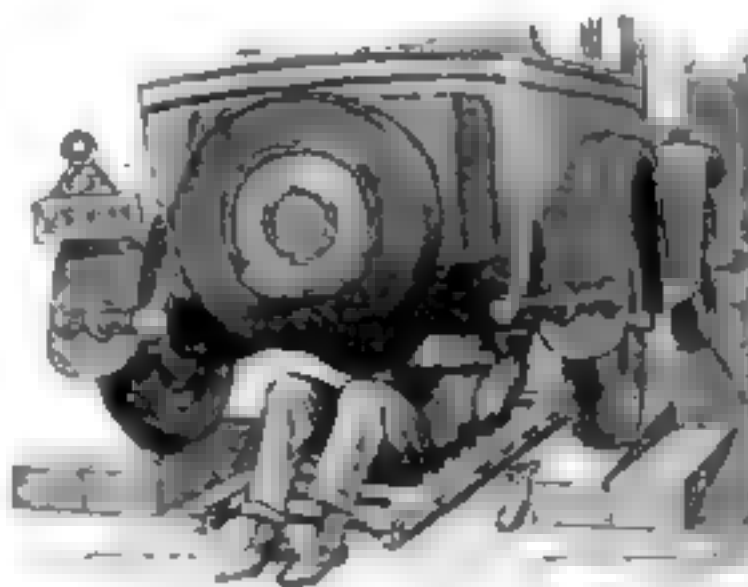


Fig. 1. By using wooden blocks you can get more space in which to work under your car and eliminate the danger of the car rolling off the jack. Cutting the blocks at the incline and hinging them facilitates moving around

Two-Purpose Light Switch

A NOVEL switch arrangement that can be used for two purposes is shown in Fig. 2. The switch is mounted on a small block placed just in front of the gear shift lever. In the drawing the size of the switch has been exaggerated to show the construction more clearly. The switch should be mounted so that the gear lever will push in the block to which the switch spring is attached only when the gear shift lever is moved to the left and forward, in which position the gears are in reverse on all new cars. The switch can be wired in parallel to the regular stop light switch so that the stop light will be lighted at all times when the car is in reverse. Or if you have to back your automobile out of a long driveway in the night time, you can fit a small spot light on the back of your car and wire it by way of this switch to the storage battery or the ammeter. Then when you push the lever into reverse in

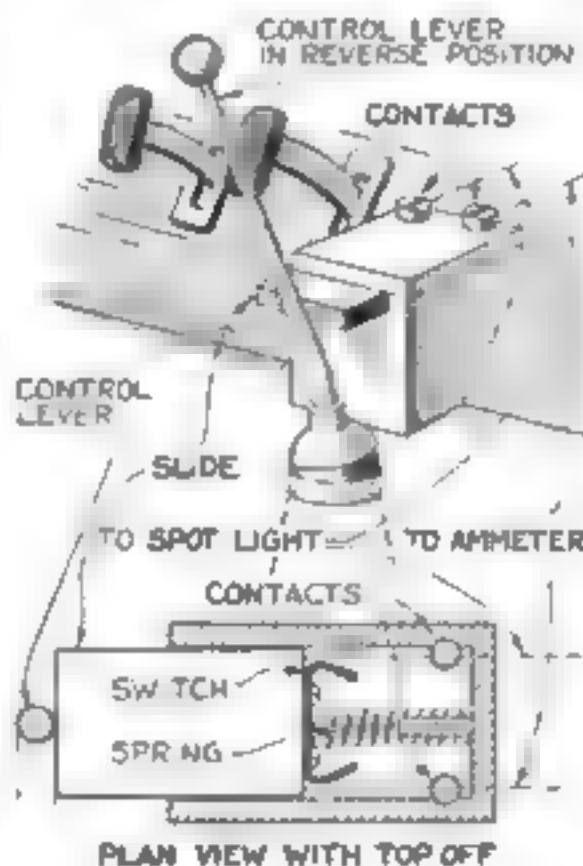


Fig. 2. A switch like this can be wired to turn on a spot light fastened to the back of the car so that you can see your way when backing

order to back at night, the light will show you the way.

Jack for Extra Light

THE usual method of connecting up a trouble light is to plug it into the dash-light socket in place of the dash-light bulb, but with so many of the new cars fitted with panels that are indirectly lighted this method is no longer practical. Of course, you can fit a metal spring clip to each of the two wires from the trouble light, but it is a nuisance to locate the proper points in the wiring each time you want to use the light. A simple solution of this problem is to fit to the panel an ordinary open-circuit jack such as is used for the loudspeaker of a radio receiver and then fit a regular loudspeaker plug to the end of the trouble cord. This arrangement, as shown in Fig. 3, is particularly handy if the extra light happens to be a light for your tent when camping.

When the Axle Breaks

WHEN the axle breaks on many types of cars it is impossible to tow them because the broken axle works out of the housing. If the break is close to the differential gear, the axle will support the wheel so that it will run true enough to tow the car if the device pictured in Fig. 4 is used. A wooden bar of two-by-four-inch cross section is placed as shown and wired to the rear end of the running board and to the rear end of the rear spring. A hole large enough to accommodate the end of the axle should be bored in the wooden bar. Of course extra strain is imposed on several parts of the rear axle assembly, so the car should be towed slowly and carefully, especially around corners.

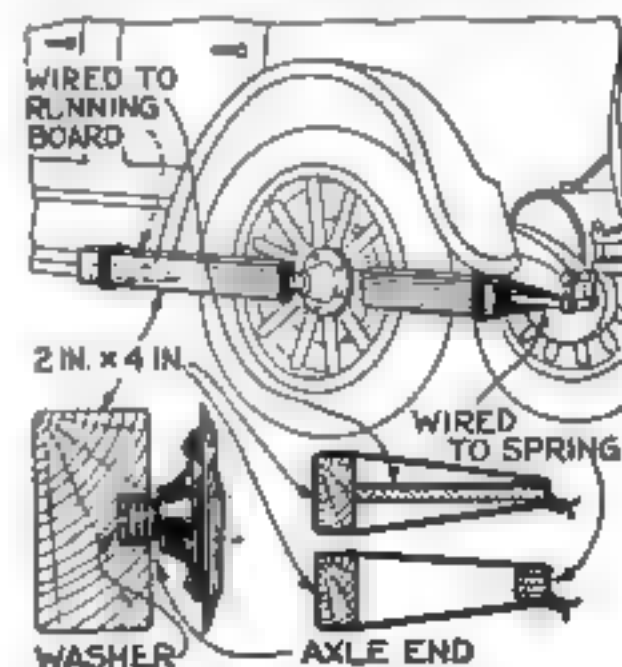


Fig. 4. Provided the axle is not broken too near the wheel, you can tow your car to the repair station by using a wooden bar as shown above

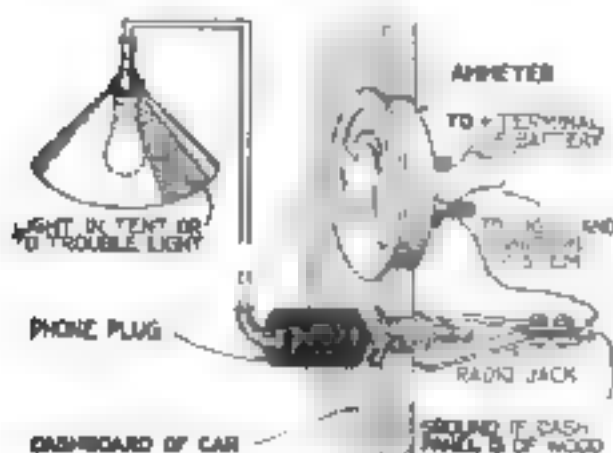


Fig. 3. On modern cars with indirectly lighted instrument panels, a radio jack and plug will prove useful for connecting up a trouble or camp light

Ten Dollars for an Idea!

RICHARD CRAIGER, of Austin, Minn., is the winner of the \$10 prize this month for his suggestion of the novel two-purpose light switch that is shown in Fig. 2. Each month **POPULAR SCIENCE MONTHLY** awards \$10, in addition to the regular space rates, for the best suggestion for motorists sent in by any reader. Other contributions that are published on this page are paid for at the usual rates.

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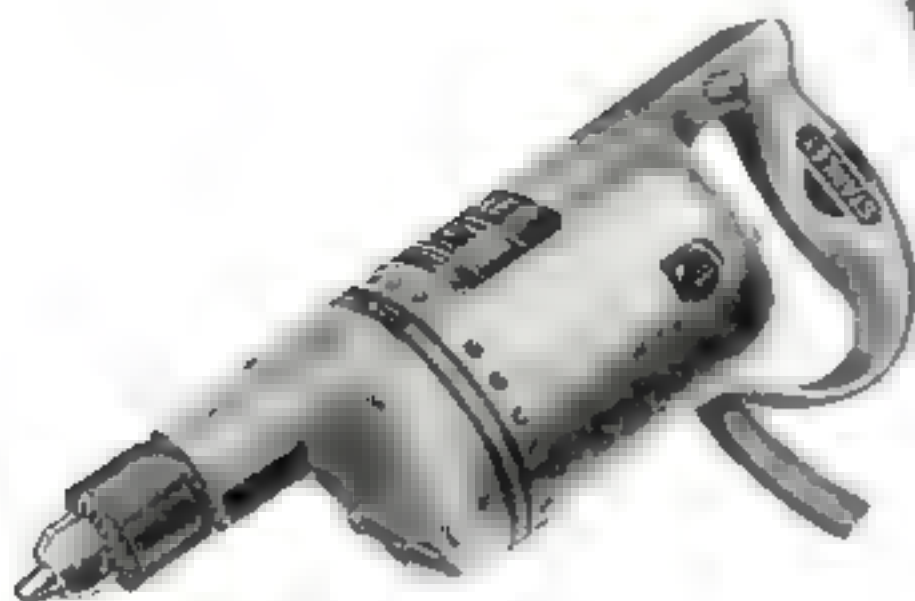
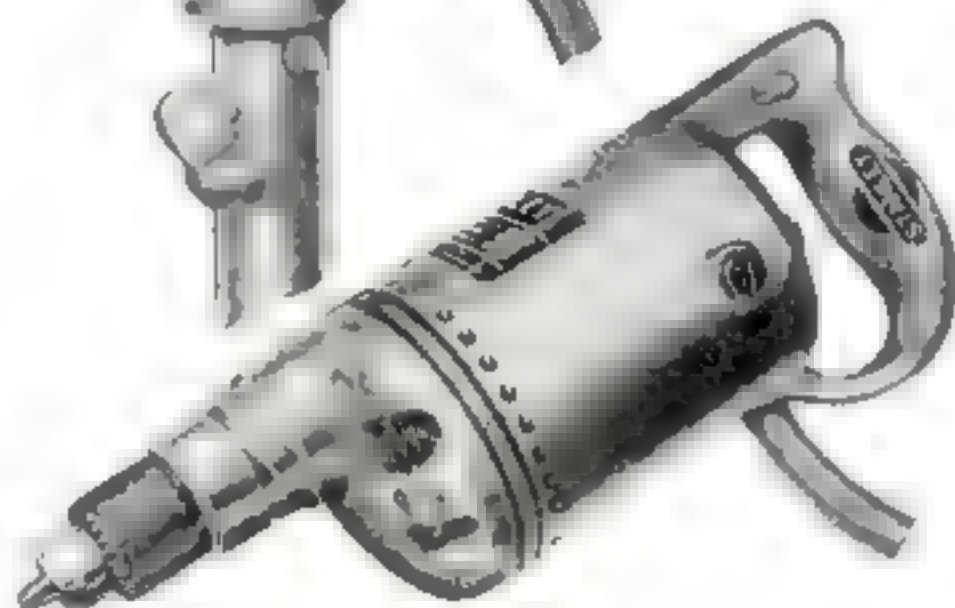
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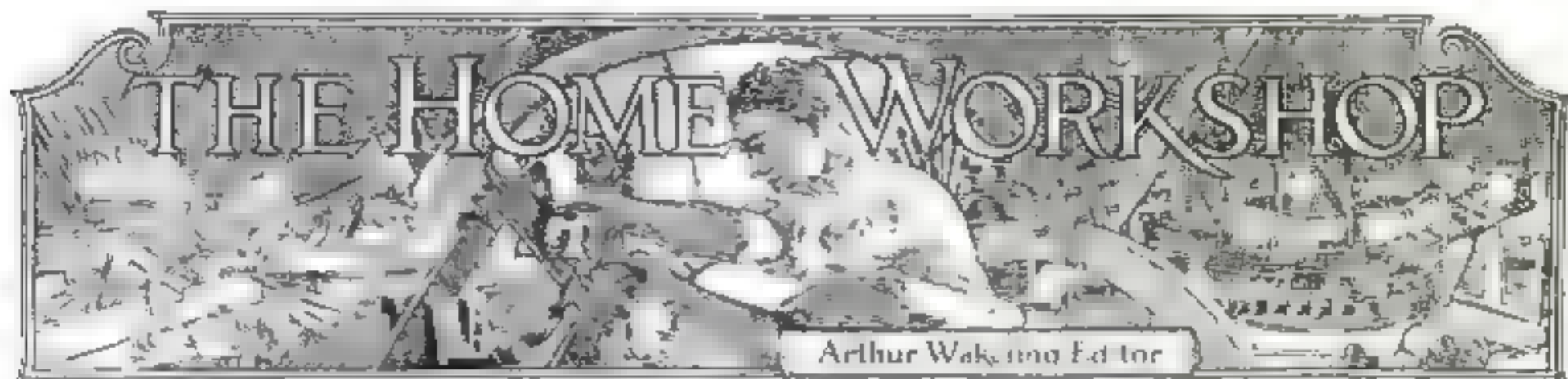
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A Real Kiddies' Playground

Convert Your Back Yard into a Child's Paradise with Simply Made Equipment

By H. V. PATTERSON

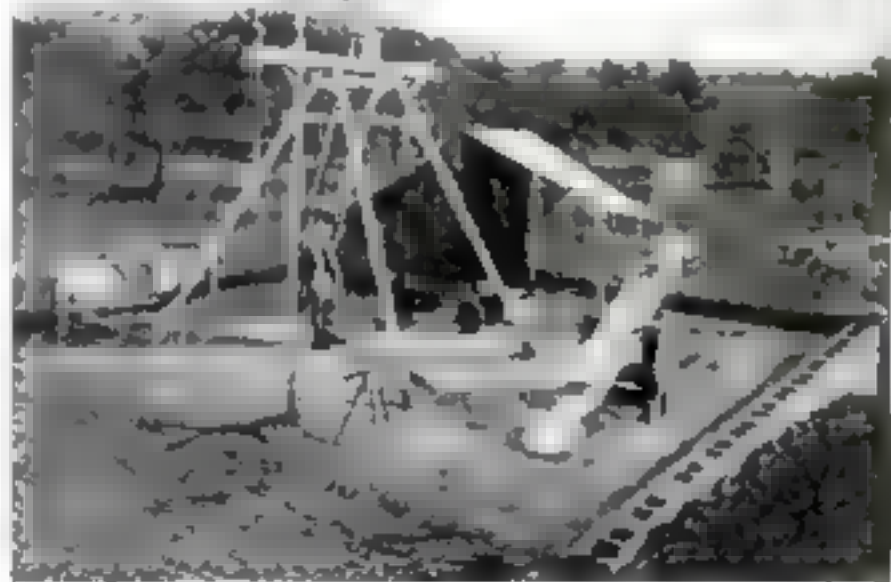
ANY boy or girl, I am sure, would like to come and play in this yard. But wouldn't it be better still to make a playground like it? There is nothing impossible about that, for any father or brother can build these simple toys and apparatus at small cost and with little work on his part.

The pressing problem of keeping children off the street, with its thousands of dangers, is most serious. With a playground like this it is not difficult to interest the children at home, and their playmates are always glad of an opportunity to be with them. It is indeed a satisfaction to mother to know that the children are happy, contented and safe, and that their health and morals are being approved.

The playground contains a trapeze swing, rings, tent, teeter-totter and flugpoles, an airplane that runs on a wire 100 ft. long and gives a real thrill, and a tank for miniature boats, which every mother will appreciate because almost all boys insist on using the bathtub for this purpose. The apparatus is painted white and trimmed in green. Incidentally, the machine gun, sailboat, battleship and windmill are all homemade toys.

In purchasing the lumber for play-

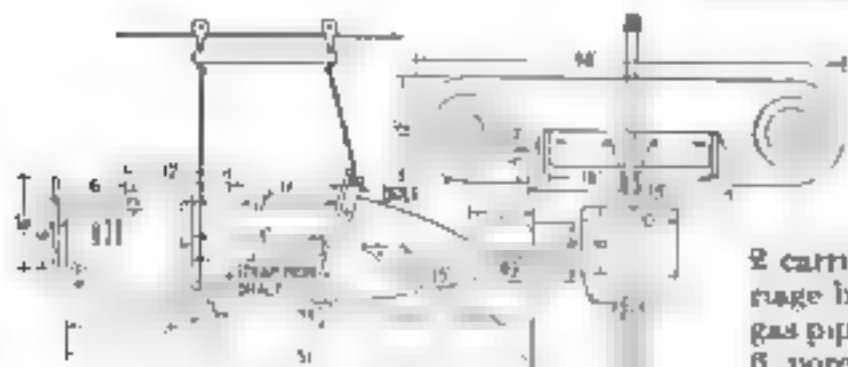
ground apparatus, choose clear, straight-grained oak and yellow pine for all parts that must be strong and durable. Common grades of spruce and hemlock are cheaper, but you will experience a great deal of difficulty if you purchase them for this work. Strength and durability



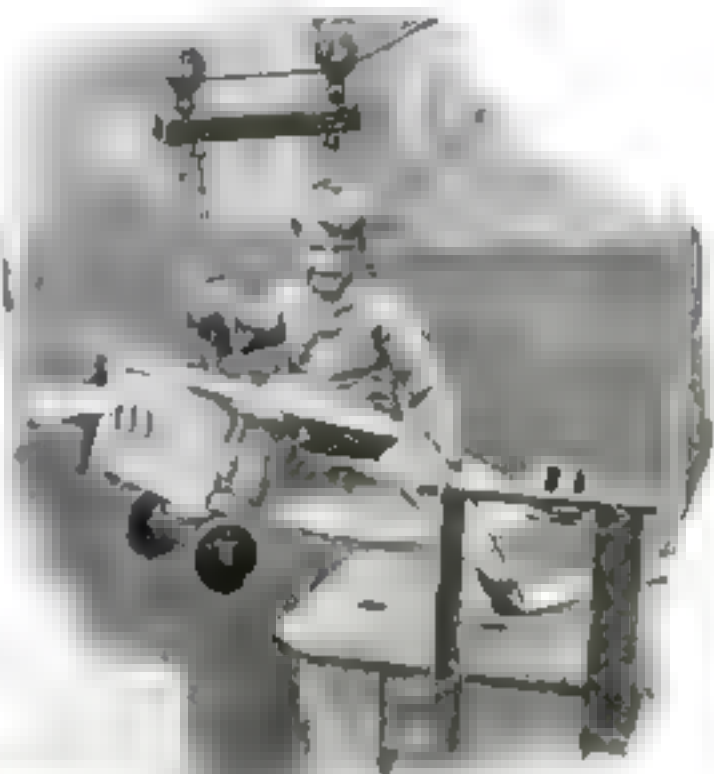
At the right is the airplane shown above. The teeter-totter swing and trapeze in the foreground and the boat tank at the left will provide hours of beautiful outdoor amusement for the children.

are of the utmost importance in this work.

The materials necessary for the trapeze, swing and rings are as follows: 1 pc. 1 by 2 in. by 12 ft., 1 pc. 2 by 3 in. by 8 ft., and 4 pcs. 2 by 2 in. by 8 ft., all oak; 1 pc. $\frac{1}{2}$ in. by 1 in. strap iron, 6 ft. long; 10 carriage bolts, $\frac{1}{2}$ by 3 $\frac{1}{2}$ in., 2 carriage bolts, $\frac{1}{2}$ by 5 in.; 2 carriage bolts, $\frac{1}{2}$ by 5 in.; 2 pcs. $\frac{1}{2}$ -in. gas pipe, 4 in. long; 4 washers, $\frac{1}{2}$ in.; 6 porch swing hooks, 1 set porch swing chains, 2-1 $\frac{1}{2}$ -in. eyebolts. It simplifies the construction greatly if you have a planing mill cut and plane the lumber.



The dimensions for the airplane. Make sure that the chains are securely fastened and adjust it so that the tail skid strikes the ground first, thereby acting as a brake.



This airplane, sliding down a 100-ft. wire, will provide a fascinating thrill without danger if properly constructed.

First cut the 2 by 3 in. cross-beam to a length of 7 ft. and bore a $\frac{1}{2}$ -in. hole 30 in. from each end. Now lay out the four 2 by 2 in. legs, which are 7 ft. 10 in. long. Cut the upper end of each on an angle so that they will spread 6 ft. 8 in. apart at the bottom. When in place, bore a $\frac{1}{2}$ -in. hole at the upper end of each, 1 $\frac{1}{4}$ in. from the top, to correspond with the holes in the cross-beam, also bore a $\frac{1}{2}$ -in. hole 18 in. from the upper end. Cut two 1 by 2 in. braces 32 in. long and bore a $\frac{1}{2}$ -in. hole 1 $\frac{1}{4}$ in. from either end. Bolt them in place as indicated in the drawing on page 98. Cut four pieces of the 1-in. strap iron 18 in. long, drill a hole in each end, and bolt them in place. Cut two 1 by 2 in. pieces 28 in. long and bolt them 28 in. below the top of the cross-beam. Place the six screw hooks in the cross-beam at the locations shown in the drawing.

Cut two chains 70 in. long for the swing. The seat is a piece of 1 by 6 in. oak 18 in. long. Bore holes for the two eyebolts and fasten the chains in place.

The trapeze is made of two pieces of chain 32 in. long and a broomstick grooved to hold. (Continued on page 98)

Next We Make the *Mayflower*

Step-by-Step Instructions for Building an Exceptionally Beautiful Model of the Pilgrims' Ship—The Work Is Relatively Easy and the Materials Cost Little

By E. ARMITAGE McCANN

As seventh in its series of famous ship models, POPULAR SCIENCE MONTHLY presents the *Mayflower*. This staunch little vessel, because of its historical significance and its fame in song and story, has perhaps a more personal and human appeal than any other. Whether or not you have built a model before, you can construct our simplified version of the *Mayflower* without difficulty. You will find the task a pleasant one, and the finished ship will be a constant source of satisfaction; indeed, it will increase in decorative quality with the years, like all good craftwork.

WHILE there have been and still are several vessels called "Mayflower," we think of only one ship when the *Mayflower* is mentioned—that which bore the Pilgrim Fathers to Plymouth in 1620.

Detailed instructions will be given in this and succeeding articles to help you build a model of this famous ship. Those who desire may, of course, omit many of the less important details, although when one sees a model growing beneath one's hands it is rarely one cares to sacrifice anything that may add to its beauty and perfection.

There is an unescapable fascination in ship model making. If you undertake the construction of this ship, your enthusiasm will increase as you proceed. It is, indeed, an exceptionally interesting model on which to work. Many of those who have seen the original have ranked it first in

Model of the *Mayflower* designed for the readers of POPULAR SCIENCE MONTHLY by Captain McCann with data made available by the courtesy of the Pilgrim Society

beauty among all the ships in our series of historic models. Should you still be working on a previous model, be sure to save each article about the *Mayflower* for future use.

Not much is known about the *Mayflower*. She was of about 180 tons and was not very new at the time of her voyage to the New World. It is claimed that she was a whaler before and after her several trips with the English settlers, it is more likely that she was the *Mayflower* which was registered as trading to western European ports in 1588, but she may have gone whaling in her later days under American ownership.

BY THE measurement of that time, 180 tons gives us a vessel of about 80 ft. from stem to sternpost, which would indicate a beam of about 28 ft. These are the measurements adopted here. Reduced to the scale of $\frac{1}{2}$ in. equals 1 ft., or 1 in 64, they give us a model 16 $\frac{1}{4}$ in. long on the waterline with an extreme beam of 5 $\frac{1}{4}$ in., or 22 $\frac{1}{4}$ in. by 10 in. high, overall.

As for the shape of her hull, deck fittings, rigging and the like, one can be guided only by the practice of the time and build a typical English merchant ship of her size and period.

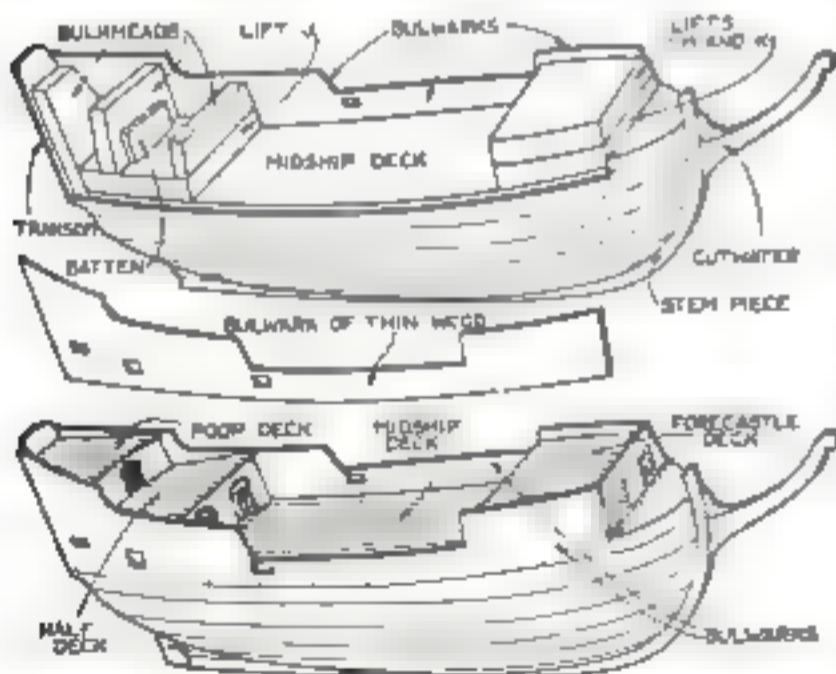
For the lines and details used, I am indebted to R. C. Anderson, Vice President of the English Society for Nautical Research, who spent nearly three years in research and in building a model for the Pilgrim Society of this country. That model is housed at Pilgrim Hall, Plymouth, Mass. The Pilgrim Society has been kind enough to lend me the data from which I built my

model. One cannot, of course, expect to build as fine a model in three months as one that took years, thus, although I am only too glad to acknowledge the source of my information (impossible to find elsewhere in this country), I do not wish to make Mr. Anderson or the Pilgrim Society in any way responsible for my efforts. I can, however, claim that my model, as illustrated and described, is a reasonably correct model of a ship such as the Pilgrims probably used, with as much detail as most model makers will wish to embody. Those who carefully follow instructions will have a worthy representative of the Pilgrim Fathers' *Mayflower*.

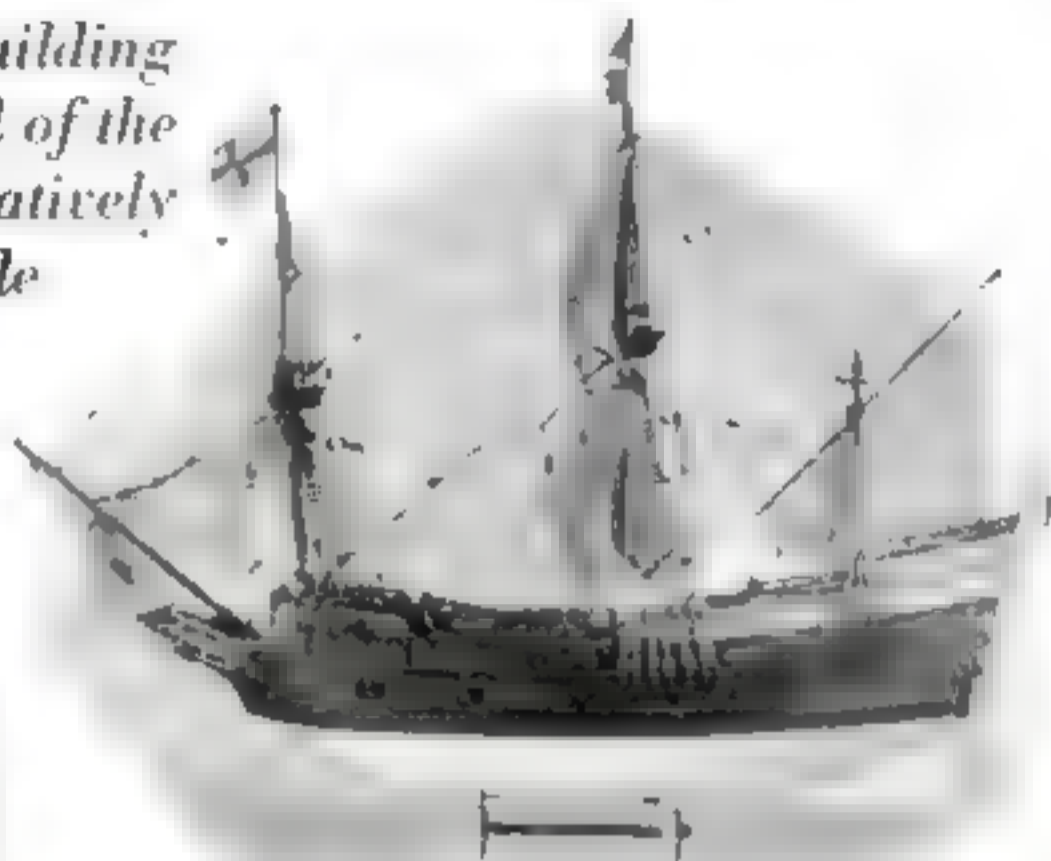
To make this model, the first necessity is full sized drawings of all parts. These may be enlarged from the plans given here, but this laborious work is not worth while when one can obtain them to full scale by sending to POPULAR SCIENCE MONTHLY for Blueprints Nos. 83, 84 and 85 (see page 102).

THE usual domestic kit of tools will be sufficient with, in addition, a fret saw, small wooden spokeshave, a half-round file or rasp or a convex spokeshave, a small toothed tenon saw, or, better, a jeweler's saw, some small C-clamps, a very light hammer, a small nail set, and some very small wire twist drills (say Nos. 65 to 80), with a pin-vise handle. A set of die-sinker's files are handy for making small parts, and some small round-nosed and side-cutting pliers. For the rigging there will be needed tweezers, embroidery scissors, a crochet hook and some crewel or fine darning needles.

The material needed will be referred to as required. A complete bill of materials will be found on blueprint No. 83. The important items are the pine for the hull, thin three-ply wood or pine for the bulwarks, rattan (cane) spline for the wales and handrails, a few dowel sticks for the spars, several thicknesses of fish line for



The hull is constructed of layers that are sawed out, glued together and shaped; then bulkheads, bulwarks and overlays are added



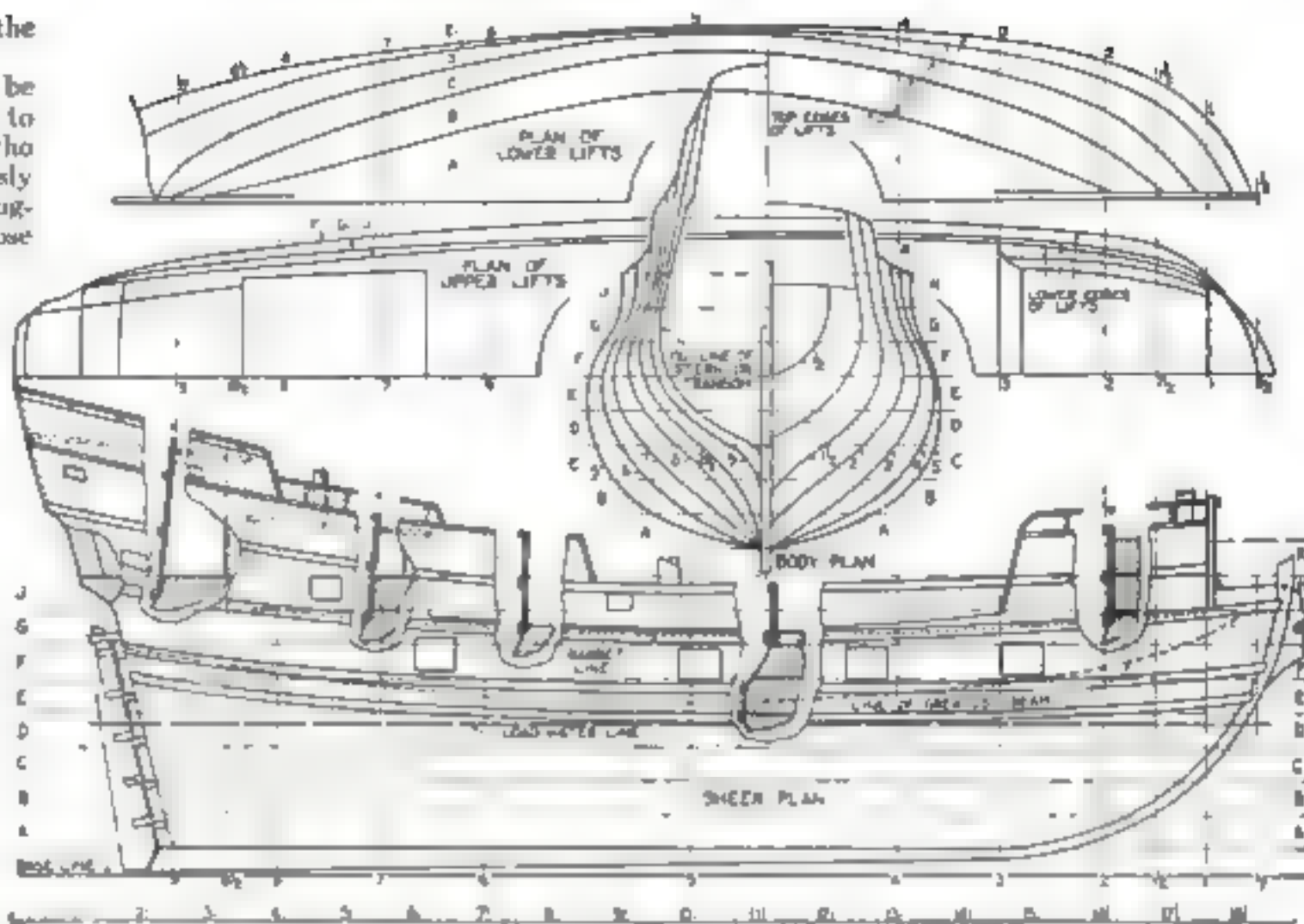
the rigging, and canvas for the sails.

To save space, it will be necessary in some instances to use nautical terms. Those who have built models previously will have no difficulty in recognizing their meaning; those who are not familiar with them will find that they are defined in all unabridged dictionaries and often illustrated as well. Furthermore, the majority of them are indicated clearly on the blueprints.

The hull of the Plymouth Hall model is built with frames and planks, but this method entails a tremendous amount of work. For instance on the lower deck alone some 1501 iron nail pegs were used. Our model will be built on the lift, or layer system. Those, however, who have had the necessary experience and wish to build with frame, beam and planking, can use the lines here given.

For the lifts, clear white pine is the best wood. One board dressed to $\frac{3}{4}$ in., $5\frac{3}{4}$ in. wide (nominally 6 in.) and 10 ft. long will be wanted. They could, however, be cut more economically from a 6 or 10 in. board 6 ft. long.

ON THE board mark the outlines of the lifts from the plan of lifts. The eight lifts A to G are full length, H and K are short pieces to form the fore-castle, and J is a short piece to make the lower part of the stern. It will be noted that the upper edges of A to E are given, because from the keel to the middle of E the hull increases in beam as it rises. From that point it starts to narrow, or tumble-home; therefore, the lower edges of the upper lifts are the widest amidships, while at their ends it is the upper edges that are shown, because, as may be seen from the line of greatest beam, and the body plan, the beam continues to increase



The lifts or layers, only half of each being shown, the body plan, which represents the cross section at the various construction lines, and the side elevation or sheer plan of the hull. These and other drawings appear full size on Blueprints Nos. 83, 84 and 85 (see page 10). The blueprints will save you the tedious task of making your own full size layouts.

at the ends. It is the middle of lift E that is given. In a word, it is the greatest width of each lift at any place that is shown.

There is only room to show one half of each lift. To get them from Blueprint No. 83 to the wood, the easiest and safest plan is to transfer them first to tracing paper. Carefully mark the center line and the cross construction lines, turn the tracing paper over, pin it down with the construction lines coinciding, and mark in the other half of the lifts. You will now have drawings of the complete lifts, which, in turn, can be transferred to the wood by sending through carbon paper, using a sharp, hard pencil.

Mark the midship lines and crosslines on each piece and extend them over the edges, using a square. The lifts above G are better cut somewhat long, to be sawed down correctly when all are glued up.

To reduce the weight and make the hull less liable to warp and show cracks at the seams, it is advisable to hollow lifts B to F to within about $\frac{1}{4}$ in. of the upper edges of the lifts below. Lift J may also have about a square inch cut out from the sides where the gun ports come, between lines 7 and 8, if it is desired to have those ports open with guns made.

Glue lifts A to G together, with all construction lines coinciding, and leave them in clamps or under heavy weights for a day. Then nail and glue the other pieces in position. The piece K brings one a trifle short of the height shown in the sheer plan. The fore-castle may be reduced by

that amount, but it is better to glue on a thin wedge-shaped piece to bring it up.

From a piece of stiff cardboard cut templates to the bow and stern lines (sheer plan) and to the body lines (body plan). On each carefully mark the midship line and where the top edge of lift D cuts it.

Plane the bottom away from line 6 forward, $\frac{1}{4}$ in. deep at line 3. The keel will later extend up to the bottom of this lift, aft.

Continue the midship line from stem to stern along the bottom.

WITH a colored pencil mark in the line of greatest beam, to be left visible until the final sandpapering. Cut away the projecting corners until the bow and stern templates fit at the ends when held at a right angle to the hull, with the D-E mark at the correct position. Similarly shave away the projecting corners at the sides until the templates fit at their respective positions 1 to 9. Start amidships and bring the whole down gradually.

Shave down the middle of the midship deck to the line shown in the sheer plan, leaving it a full $\frac{1}{4}$ in. higher in the center than at the sides. A similar camber should be given to all decks, but this deck can more easily be shaped before the upper lifts are glued on.

The sharp semicircular curve of the counter—the curve at the stern, above the rudder—can best be cut with a gouge, but the rasp will serve. Note its slight curve up and aft to the middle.

The ends of the lifts should be flat $\frac{1}{2}$ in. across, to take the stem and sternposts. Leave the after ends of the lower lifts very full until the keel and sternpost are on; then shave them down to meet.

Cut H down to the deck line as shown, right forward.

The stem, stern and keel are best made from hardwood. (Continued on page 119)



Captain McCann shows how the bulwarks are fastened to the hull of his model of the Mayflower. Note the after bulkheads.

Power Unit Built at Low Cost

For Use with the New Popular Science Electric Set—Amplifies and Supplies Current

By ALFRED P. LANE

HERE is the low power amplifier and current supply unit to complete the electric radio receiver described in the February issue of POPULAR SCIENCE MONTHLY. We call this a low power unit because it is capable of only half the volume with good quality obtainable from the high power unit described in the March number. But the term "low power" is only relative. Actually this unit employs two type-171 power tubes in a push-pull circuit and consequently it will give as much volume with perfect tone quality as can be obtained from even the most powerful factory built receiver.

The construction of the electric set of Blueprint 79 is exactly the same whether you want to operate it with the high power amplifier and current supply unit of Blueprint 80 or with this lower powered unit which is illustrated in greater detail in Blueprint 81. All these blueprints are listed on page 102.

It is up to you to decide which combination you want to build, but in order to help you choose we can sum up in a few words their essential advantages. The high powered unit will give you more volume than you will ever want to use except to supply music for dancing by a large crowd and the tone quality will be marvelous. The low powered outfit will give you about half the volume with almost as perfect tone quality at a saving of about thirty dollars in the cost of the parts plus the use of less expensive tubes.

NOTE, however, that if you are located where radio reception is poor or you are a long distance away from stations, the high powered outfit has an advantage aside from its ability to handle plenty of volume; that is, it actually amplifies weak, distant signals more than twice as much as the lower powered outfit. This is because the 210-type power tube amplifies more than twice as much as the 171-type tube used in the amplifier and current supply



Fig. 1. The power amplifier and current supply unit as seen from above. You can identify the parts by referring to the diagram below.

Blueprint 81 Will Help!

ORDER Blueprint 81 (see page 102). It gives large, clear wiring diagrams as well as many of the lesser details that could not be included here.

The Popular Science low power unit for electric radio set and the receiver itself (Blueprint No. 79) have been tested and approved by the Popular Science Institute of Standards.

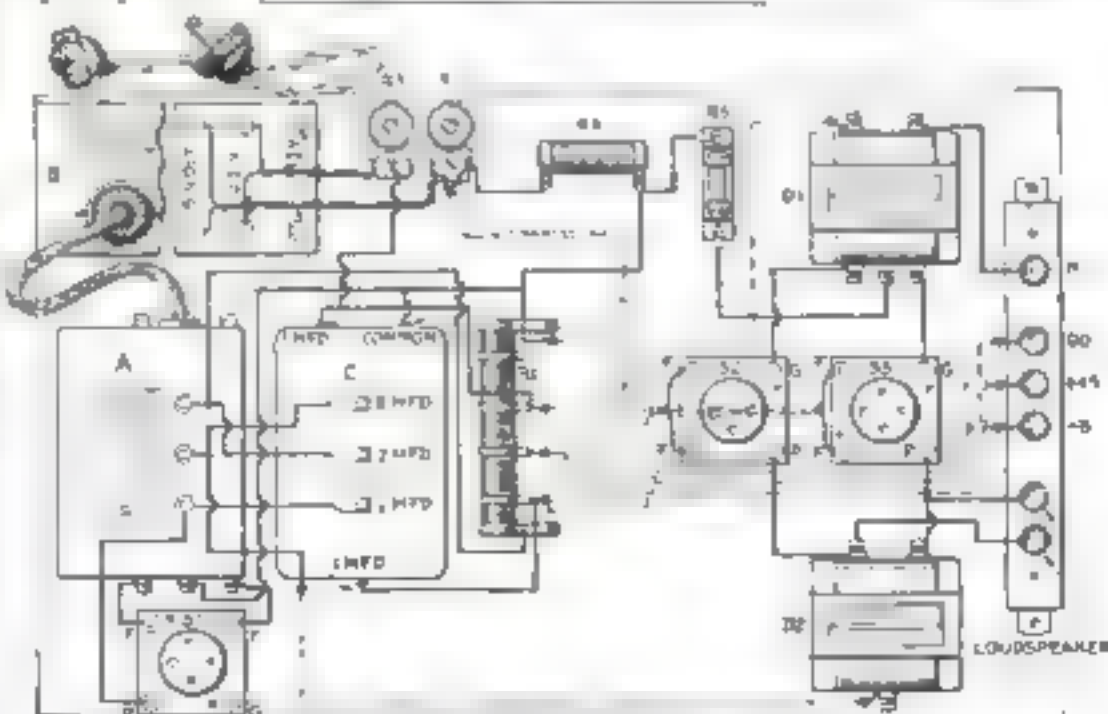


Fig. 2. In this picture wiring diagram the binding post side of transformer B has been turned around so that you can see the connections. The 2 and 1 volt leads from electric set are clamped under the binding post on transformer B.

unit described in this article.

Study Figs. 1 and 3 and you will agree that this unit looks simple to build. It is just as simple as it looks—merely a matter of building a good, solid baseboard, screwing the apparatus to it in the positions shown and following the diagram for the relatively few connections.

The construction of the baseboard follows the design given last month for the more powerful unit except that it is shorter and consequently requires only two crosspieces. It is 11 1/4 in. wide and 18 in. long, made of two or three narrower pieces of 3/8-in. board screwed to crosspieces of the same thickness. This allows room underneath for some of the wires.

You will need these parts to build this low power amplifier and current supply unit for the POPULAR SCIENCE electric radio set:

- A—Power supply unit, which includes A1, the high voltage transformer; A2 and A3, choke coils; A4 and A5, buffer condensers.
- B—Filament heating transformer with 5-volt, 2 1/2-volt and 1 1/2-volt windings.
- C—Condenser block with the following five sections: 2 mfd., 100-volt; 2 mfd., 400-volt; 8 mfd., 400-volt; 1 mfd., 400-volt; 1 mfd., 400-volt.
- D1—Input transformer.
- D2—Output choke.
- R1—14,000-ohm heavy duty fixed resistance, tapped at 11,000, 8000, 5000 and 2000.

R2—20-ohm potentiometer.

R3—40-ohm potentiometer.

R4—1000-ohm fixed resistance rated to carry not less than 40 milli-amperes.

R5—25,000-ohm fixed resistance.

S1, S2, and S3—Standard X-type vacuum tube sockets. Sx binding posts, flexible enameled fabric-covered wire, 1 type-BH rectifying tube and two UX 171 amplifying tubes.

BEFORE you start assembling the apparatus, study the picture wiring diagram of Fig. 2. (Continued on page 102.)

C & L Everedy 158

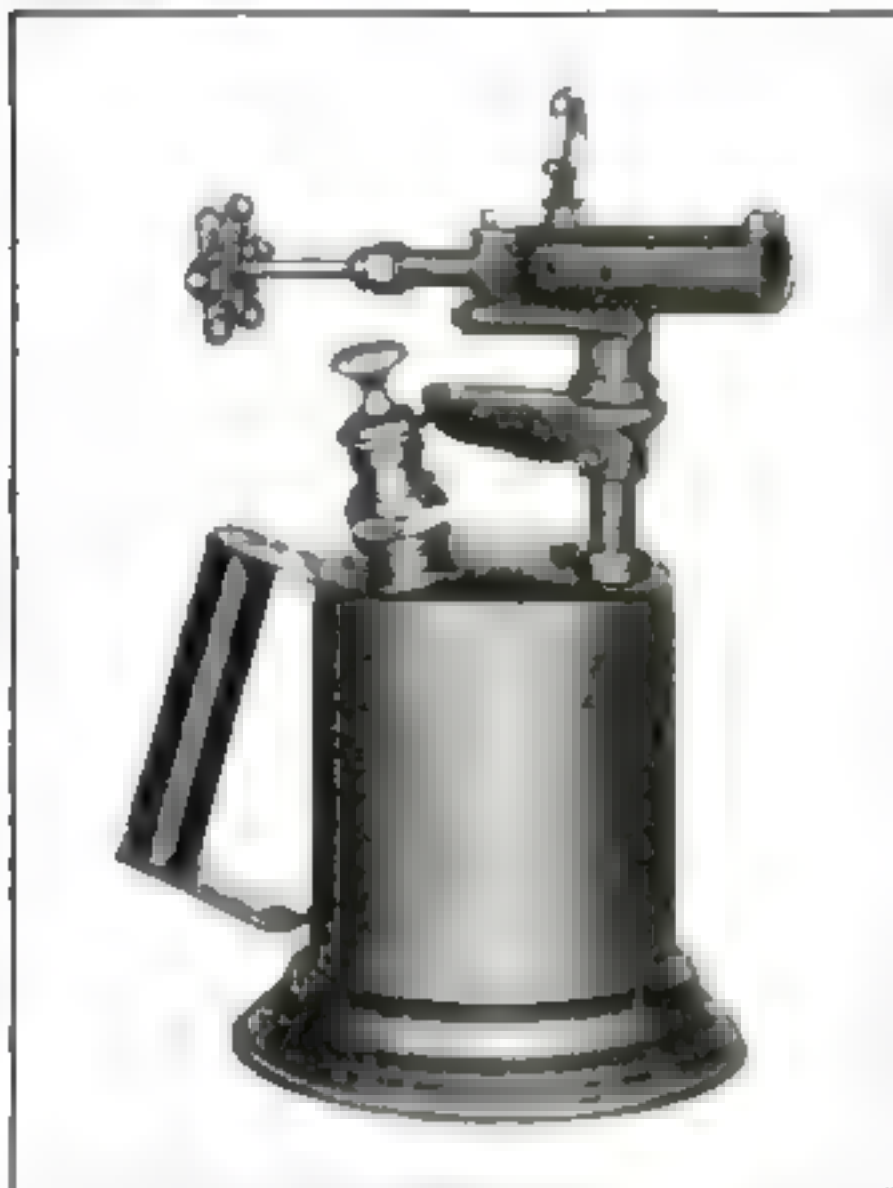
This blow torch is especially made and priced for the man who likes to do odd jobs around the house, or to tinker with mechanical things. It is very substantially made, produces a hot flame quickly, and gives real satisfaction. It will last a lifetime if it is not abused. Most hardware, electrical and automobile accessory stores have it—or can get it for you quickly.

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You'd be surprised what a lot of things there are inside of a blow-torch. When you buy one you have to take those insides pretty much for granted—the outside won't tell you a thing. Yet the insides of blow-torches differ considerably, making one work better and last longer than another.

If you'll take a look, next time you're buying one, and make sure the name Clayton & Lambert is on it, you can be mighty certain you're getting the torch that will do the job you want it to do, will keep on doing it in fine style, and that the price represents the best value you can buy.

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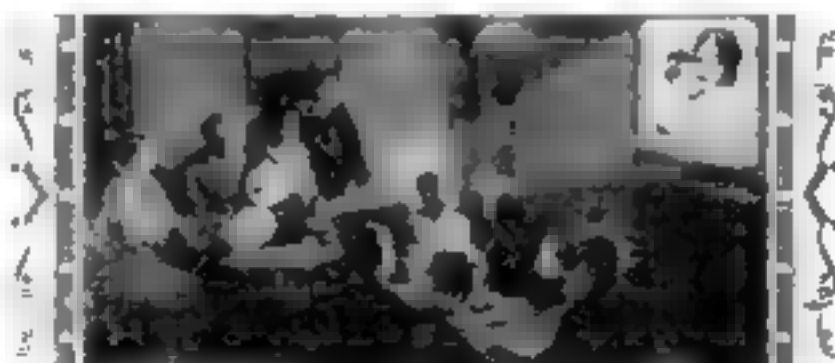
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Jobbing Shop Short Cuts

Keep Vertical and Horizontal Turret Lathes Set Up to Save on Short Runs

By ALBERT A. DOWD

"**H**ERE'S a good job for you to start off with," said Jones, the foreman, as he handed the new workman a blueprint of the flywheel shown in Fig. 1. "You can use that 20-in. lathe by the window. Twenty-five of the flywheels are piled up alongside of the lathe, and there are twenty-five more coming from the foundry tomorrow, fifty pieces in all. We figured the job pretty cheap to get the work, so see what you can do with it. You'd better hold it in a three-jaw chuck by the inside of the rim and machine the center hole and recess, and turn and face the rim. There is a grooving tool already made for the groove in the rim. After you have finished this side of the work you can bore out a set of soft jaws to sixteen-inch diameter, turn the work over and hold it by the outside. Then face the other side of the rim and the center hub. The only close hunt is the center recess. A good commercial finish on the rest of it will be satisfactory."

John Deaton, the new machinist, was a progressive young fellow who had been working for several years in another shop where high production machines and methods were employed. Over production had brought about shorter hours and only four days a week. The opportunity for putting in full time in a jobbing shop had seemed better in every way than

the old job on part time.

While the foreman walked down toward the other end of the shop, John stepped quickly across the room, looked at the pile of cast-iron flywheels, examined the 20-in. lathe—which was a new one apparently in fine condition—and then set to work.

Acting first on the foreman's suggestion, he placed a flywheel on the chuck and adjusted the jaws to catch the inside of the rim. Not finding just the assortment of tools required, he sought the tool crib, passing on his way two vertical turret lathes, one 24 in. and the other 42 in. The fact that both machines were standing idle gave him an idea. He hustled to get the tools and returned to his lathe, where he set to work, facing, boring, turning, recessing, and grooving the first flywheel took him a little over three hours, which included the time necessary to get the tools, adjust jaws, and so on. He figured that he could do the next one in about two hours, but the method seemed altogether too slow. He hunted up the foreman.

"About how long, Mr. Jones," he asked, "do you figure it ought to take to machine these flywheels the way you spoke of on the twenty-inch lathe, both operations?"

"I estimated about two hours apiece for the lot of fifty pieces. We've got to get them out at about this rate or lose money, and we don't want to do that. Don't you think you can average as good or better than this?"

"Yes," answered John thoughtfully. "I can do it all right, but I have an idea that I can make better time if you'll let me machine the work another



"If you leave the machine this way, Mr. Jones, and another similar job comes along in a day or two, I could get started on it in a very short time, and wouldn't have to make many changes."

way. I would like to use that twenty-four-inch vertical turret lathe instead of the engine lathe."

"Go to it!" responded the foreman heartily. "We don't use those machines once a month or less we have some big job that we can't do any other way. If you can do the work quicker on one of them, I'll be tickled to death. It will take you several hours to get set up and that's all lost time, but if you are sure you can average better than two hours apiece on the lot, go right ahead."

JOHN had a helper move the castings over to the vertical turret lathe, and while this was going on he arranged his tools as shown in Fig. 3. He spent about four hours cleaning up the machine and getting stops set so that he was ready to go ahead. This time included the machining of one flywheel, which he had about finished at quitting time.

The foreman left him entirely alone the next morning until just before noon, when he came. (Continued on page 148)

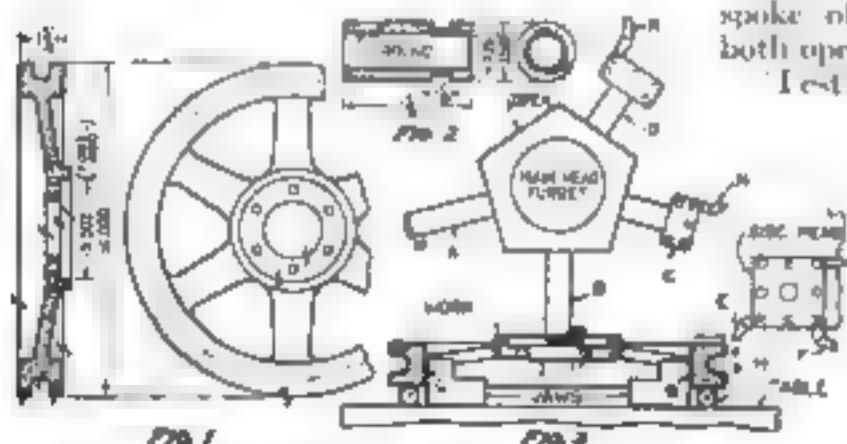


Fig. 1. The finished dimensions of the grooved flywheel. Fig. 2. The set up for a bushing of this type can easily be altered for other similar pieces. Fig. 3. Tool set-up for machining flywheel.

Other timesaving shop ideas are contained in the continuation of the Better Shop Methods Department, on pages 88, 112, 114 and 115.



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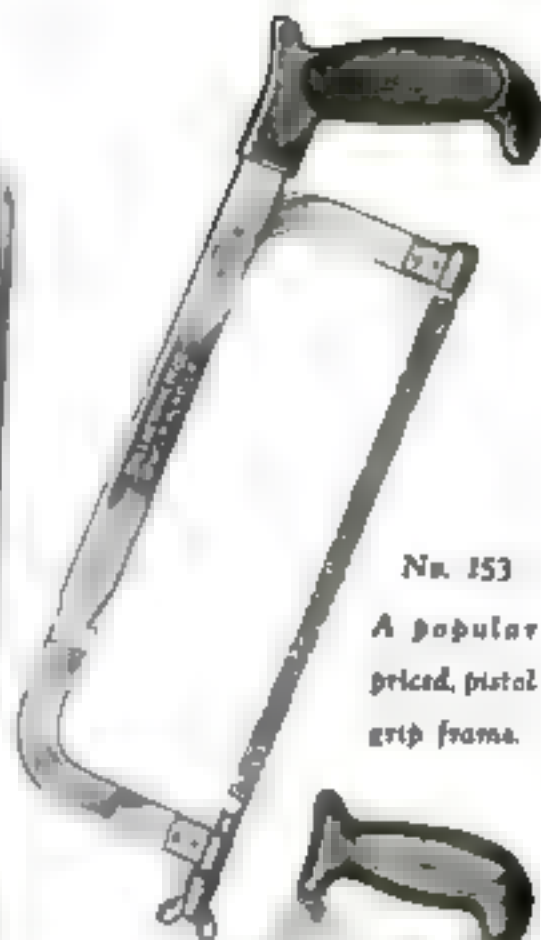
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Use Starrett Hacksaws

How to Mount Small Motors

By GEDDIE A. WILLOUGHBY

WHEN motor-driven machines are installed in a home workshop, as is so often the case nowadays, the problem of mounting the motor is of considerable importance. The secret of a satisfactory motor installation—one in which the motor will run quietly—is a good, solid foundation. Most of the noise caused by a motor is due to the vibration of the mounting rather than of the motor itself.

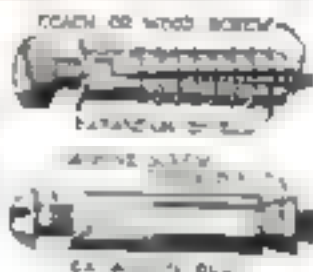
It is often possible to mount a small motor directly on a brick or concrete wall as illustrated, or on a concrete floor. As damp places should be avoided, the wall is often preferable to the floor.

When mounting a motor on brick or concrete, expansion screw anchors or shields can be used, or expansion bolts for larger motors. These are so arranged that when placed in holes in the wall and then tightened by turning in the screw or bolt, they expand and provide a rigid and permanent attachment.

First mark the points where holes are required for the expansion shields or bolts, either by holding the motor against the wall or by measuring. Then put the holes in the wall or floor with a star drill. The hole formed by the drill must



After marking the location of the holes for mounting the motor drill them just large enough for the expansion shields or bolts



be just large enough to receive the shield or bolt before it is expanded. Attach the motor by inserting the bolts or screws and turning them down tightly. Make sure that the base of the motor is held tightly against the surface.

If this method cannot be used, select a heavy timber or build a heavy frame to which the motor can be bolted

Polishing Attachment for Speed Lathe

FINISHING irregularly shaped pieces of metal is a somewhat tiresome job if done by hand. The illustration below shows a device for finishing and polishing work that is quite easy to construct and satisfactory in operation. It is used in connection with an ordinary speed lathe.

The hub of a suitable pulley is threaded to fit the live spindle; another pulley of the same size is mounted on a sliding bracket, which is carried on a frame clamped to the ways of the lathe. This bracket is provided with a spring to keep the abrasive belt at proper tension.

The abrasive or polishing belt may be purchased or made of a strip of abrasive (emery) cloth cut to the proper length and glued to form a belt. In the latter



The polishing belt is carried on two pulleys, one of which is driven directly by the lathe

case the joint is prepared by first soaking an inch or a little more of one end of the strip in hot water and scraping off the glue and emery. Then the part just cleaned is coated with glue, as is the plain side of the opposite end of the strip. The joint is pressed together and left to dry.

For irregularly shaped work, a belt without a guide, as illustrated, is the most practical, but for flat work it is desirable to place a flat guide under the upper part of the belt.—EDWIN KILBURN.

Window Shade Shields Lathe from Grinding Dust



As the carriage moves, the shade rolls and unrolls, protecting the ways of the lathe

GRINDING in the lathe, although not advisable, is sometimes necessary. The illustration shows a practical and convenient way of keeping the emery from the ways.

A common window shade is cut the necessary width. After removing the small dogs that act as checks for raising and lowering the shade, the roller is fitted in a convenient holder, which is clamped to the lathe, and the shade is fastened to the tool post under the grinder. The spring keeps the shade stretched as the carriage moves.—H. J. C.

Radius-Forming Tool for Grinding Wheels

THE tool illustrated was designed to form radius on the wheel of a surface grinder. It is 6 in. long over all and 4 in. high. It can be set for any concave or convex radius up to $\frac{1}{4}$ in. by thousandths. It is so made that the neutral point is at the 500 in. reading on the head, which was



The diamond is this radius forming device is set into a sleeve over a micrometer spindle

made from a standard micrometer.

A small diamond is set into the sleeve that fits over the spindle, a part of which has been cut off. The setting is such that the diamond is central.

The bottom plate can be removed and the tool set in the vise at any angle desired.—H. C.

Measuring and Marking Bar Stock Quickly

MOST shop foremen or stockroom employees have a 4-ft. rule fastened to the bench for measuring off the length of rods and other stock as required. To insure more accurate measurements, a piece of flat tool steel is bent at one end, sharpened to a chisel edge, and fastened



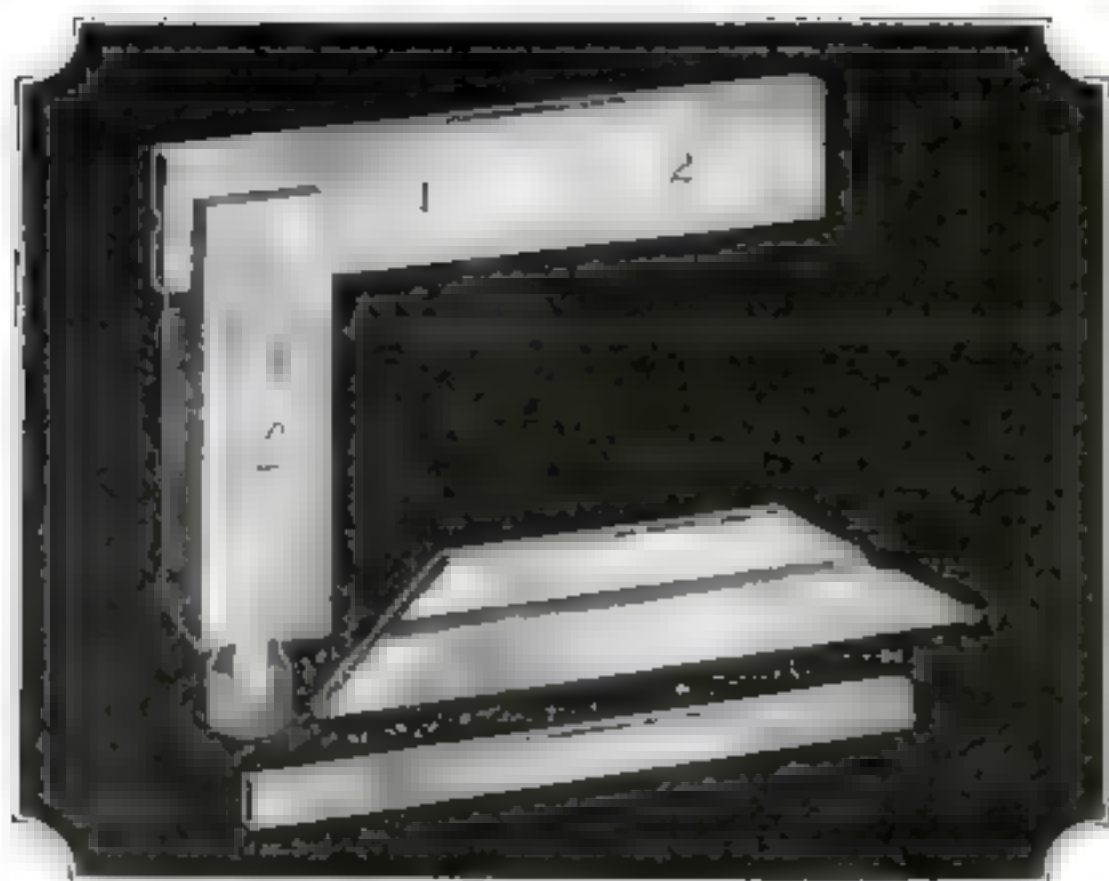
The rod is tapped against a chisel edge at the end of the rule to mark it for cutting

near the end of the bench with four screws. The rule then is screwed down on this, as shown. The rod to be measured is pushed along to the required measurement and tapped with a hammer over the sharp edge, which makes a definite mark for the hack saw.—ARTHUR KENDALL.

Floor Compound Cleans Stains from Hands

IN OUR shop we have found that the best way to remove ink and grease from the hands is to rub them with the floor compound used to keep dust down when sweeping. A pan of it is kept in the sink for this purpose. We rub on a little soap first to start a lather, and then use the compound. This cuts away stains better than anything we have used and costs little.—M. B. G.

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WORLD'S STANDARD OF ACCURACY

THE SHIPSHAPE HOME

Replacing a Broken Window Pane—How to Cut Glass—Glaziers' Points and Putty

By E. E. ERICSON

THE breaking of window glass is a frequent mishap, particularly in any home where there are small children. Fortunately, it is a comparatively easy process to replace a window pane. Any home owner who is at all handy can not only save a large part of the cost of such work but also avoid the discomfort of having to wait for the job to be done by a glazier.

In the January, 1928, issue of POPULAR SCIENCE MONTHLY page 86, appeared an article on handling glass that can be re-read with profit in this connection.

The first problem is to get out the old glass. This is sometimes not an easy task. Where it is at all possible it is better to take the window out of the opening so that it may be placed on a table while the work is being done.

To remove the old putty, use a chisel about 1 in. in width as shown in Fig. 1

rabbit or recess for the glass after the old glass has been taken out. This operation is important for if there are ever so small particles of putty left, they may cause the glass to break when it is put in place.

Next comes the cutting of the glass. If careful measurements have been



Fig. 1 and 2 Use a chisel to remove the old putty (lower view) and clean out the rabbet (upper view). Take care not to cut into the wood.

taken it is possible to have the glass cut to size by the dealer who sells it. If ordered in this way, it will very often need no further trimming before it will fit properly. It is well to make a habit of storing old glass in a protected place. When repair work is to be done, there may be an old piece on hand that can be used for setting a small pane.

For the smaller panes, the glass can be cut and laid over the frame. Place it in position and run the glass cutter directly over the edge. This is often done without a straightedge by the experienced mechanic, but it is best for the amateur to lay a yardstick along the edge as a guide for the cutter. Care must be taken not to press too hard on the cutter.

A piece of paper ruled into one inch squares is useful in cutting. The use of it is shown in Fig. 3.

The exact measurements of the frame are taken and transferred to the paper. The glass is then so placed upon the paper that the cutting line falls directly over one of the lines. The cut can be made free-hand or with the use of a straightedge.

(Continued on page 107)

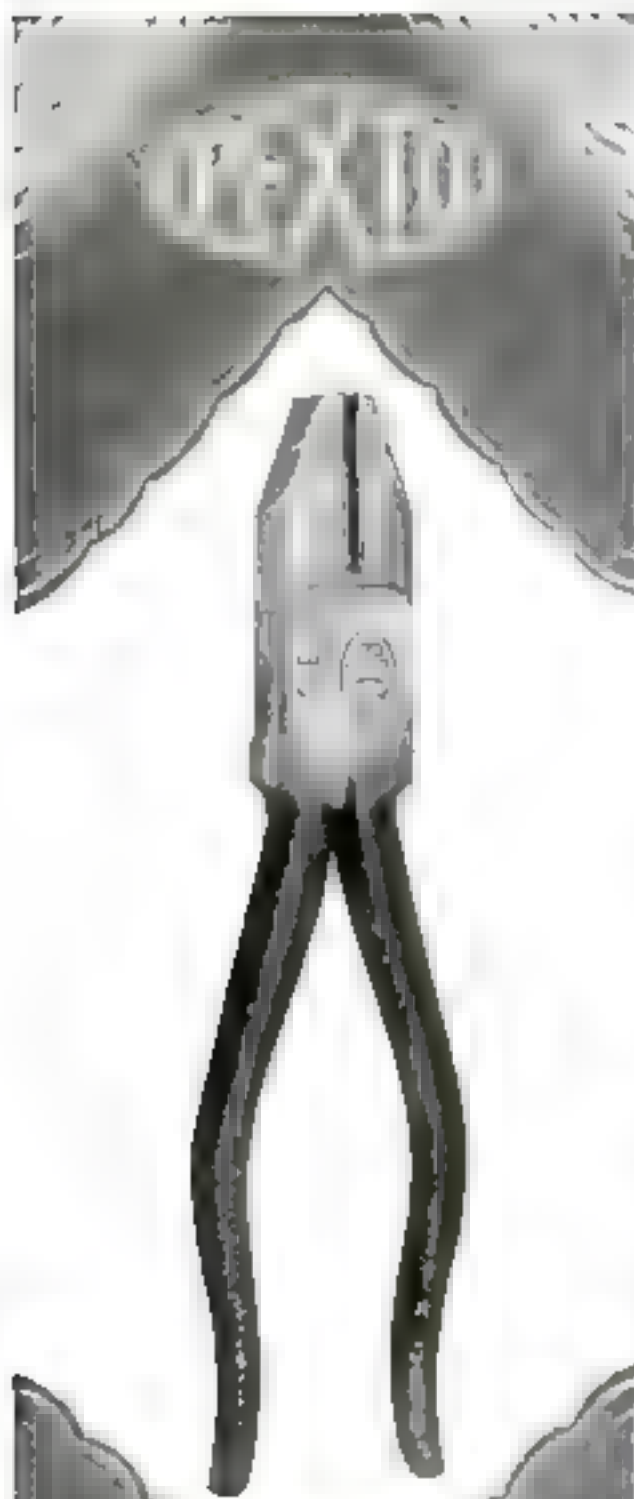


Fig. 3 A piece of paper ruled into one inch squares is useful in cutting. The use of it is shown in Fig. 3.

The next step is to break the glass after it is cut. To break the glass after it is cut, place the handle of the cutter as shown, and press down. The exact measurements of the frame are taken and transferred to the paper. The glass is then so placed upon the paper that the cutting line falls directly over one of the lines. The cut can be made free-hand or with the use of a straightedge.

Fig. 4 To break the glass after it is cut, place the handle of the cutter as shown, and press down.

In Fig. 2 is shown how to clean out the



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Making Your Jackknife Last

*Initialing to Prevent Loss—Simple Ways
to Restore Broken Blades—Upkeep Hints*

By CHELSEA FRASER

HOW long does a jackknife last? Statistics show the average knife carried by man abides with him only ten months. It is my purpose to suggest easy remedies for the general run of knife troubles. By adopting them you can make your own jackknife stand by you longer than the average.

Initialing a Knife. If your initials are on your knife it is more likely to be returned to you in case you lose it. You can make the graver from an old chisel or any good piece of tool steel. Grind the chisel or blade down to the dimensions given at A, Fig. 1, and hone the cutting edge or point on an oilstone until it is keen. Whittle out a short handle, as at B. Outline the initials with a soft pencil or a sharpened piece of soap. Set the graver as at C and push it forward, while



Knife blades that have been damaged, if short and the ground, can be repaired with a graver. As the graver is pushed forward, it creates a thumbnail of the initials.

the blade is held steady and from side to side. The rocking creates a series of V-shaped cuts, as at D.

Projecting Blade Points. To remedy these it is necessary only to grind or file off the projecting end of the blade tang, as in Fig. 3.

Repointing a Broken Blade. In the next are shown four different points you can produce by grinding and filing a broken blade tip. You may find that you will like one of these better than you will the original one. Be careful not to draw the temper of the blade during the grinding process.



Folding Screw Driver. When a penknife has been broken off you hopelessly for redemption as a cutting tool (Fig. 4) it can be transformed into a neat folding screw driver for light work. Grind off the broken

end until it is square as at B, taper the cutting edge and the back edge as at C, and slightly level the sides of the blade as at D.

Stiffening a Wobbly Blade. After a knife has been in use for some time, especially in heavy cutting, the heads of the rivets upon which the blades are pivoted often come off.

The simplest remedy is to countersink the hole slightly at the lower end, then reseat the rivet in the cavity by using a nail or a blunt pencil as at A, Fig. 5. Another method consists in withdrawing the rivet and inserting a slightly larger one made from a piece of brass wire or a wire brad as at B. This should then be headed at both ends by tapping while the knife rests on a piece of iron.

Providing a Thumb-and-Finger Grip. Sometimes it is desirable to provide a way of lifting the blade of a knife by gripping it with the thumb and forefinger as in Fig. 6. With a round file, make a curving notch about 1 in. wide in the handle of the knife, reducing both wood and lining plates.

Relieving Sticking Blades. You can usually renew the easy action of a blade that sticks by putting a few drops of kerosene oil between the bolsters and the blades as in Fig. 7 and working the blade back and forth for a few moments. Repeat the process if necessary.

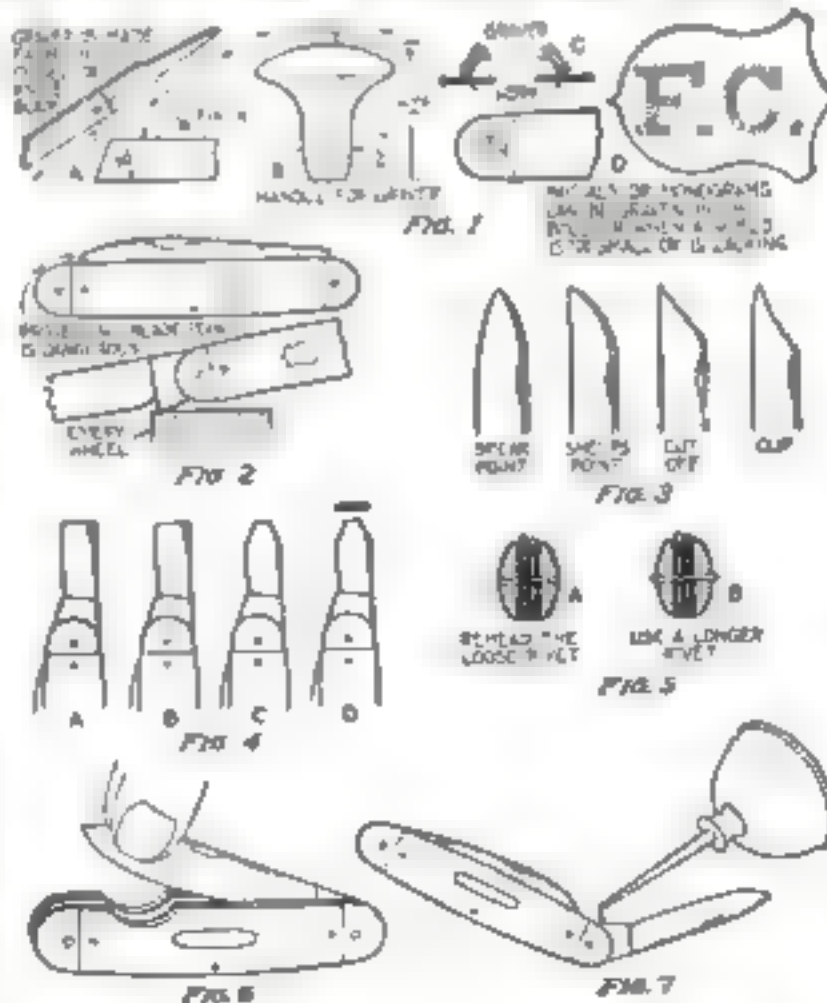


Fig. 1 shows the simple graver used for initialing. Grinding the sub is shown in Fig. 2. The evolution of a screw driver blade is indicated in Fig. 4. Other suggestions are given in Figs. 5, 6 and 7.



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EVERY now and then one runs across a canoe built years ago for serious backwoods service rather than pleasure. Rounder in cross section, sharper of stem and narrower of beam than present day craft these old canoes travel faster and easier. They are true thoroughbreds of canoeedom, the nearest approach in form and construction to the Indian's birch bark, and the enthusiast views them with a thrill.

The repair of a worn-out craft of this kind, being an extreme example, will serve admirably to illustrate the proper methods of approaching less extensive general maintenance work on canvas covered canoes.

The old canvas skin must be taken off to allow broken ribs and cracked planks to be mended. When the outwales have been removed, pry out the small copper tacks with a sharp knife and peel off the old covering.

The easiest way to strengthen a cracked rib is to screw on a piece of 1/2 in. brass as wide as the rib and long enough to lap the cracked portion generously. Counter-sink the screw heads and carefully round the edges of the brass. If, however, the crack is not too serious, open it by applying pressure from outside the hull, run in some waterproof glue and allow it to close. A rib broken in two places, or one producing a bulge in the planking at the point of fracture must usually be removed—either the entire rib or that half in which the breaks appear.

TO OBTAIN a pattern for the form necessary for bending the new rib, prop a paper covered board in the canoe over the removed rib. Then, by using a pair of dividers as indicated in the illustration on page 105, you will be able to produce the correct outline. Transfer this to the floor and drive along it at 2-in. intervals a row of tenpenny nails.

Steaming the rib will not prove difficult, any box, even though roughly made, will hold enough steam to soften so small a piece. It may even be sufficient to wrap the rib in cloths and pour boiling water over it. Place the softened rib against the nails and, working from the

Broken Ribs—Cracked Planks—Loose Bolts—Covering and Patching

By J. V. HAZZARD

center, drive additional nails to hold it there until dry, when it can be put in the canoe in the usual manner.

Longitudinal cracks or checks in the planking of canvas covered canoes need but little attention, as the ribs are so close and wide as to take up the strain, but splintered or badly broken planks should be cut with a sharp chisel over the center of a rib well back from the break and a new piece of similar wood substituted. It should be well seasoned.

Unless the new plank has to fit the turn of the tumble home or the reverse curve near the bow, it will be unnecessary to steam it. Dig into the plank and cut off the nailheads in the damaged portion of the planking so the nails can be driven back with a small punch and drawn through from inside without damaging the ribs. Shaping the new piece will be a case of fit and try, although if the nails near the edges are countersunk a bit when clenched, a plane can be used to fair up the surfaces after the piece is in place.

All bolts and screws must now be tightened. When they are rusty they are



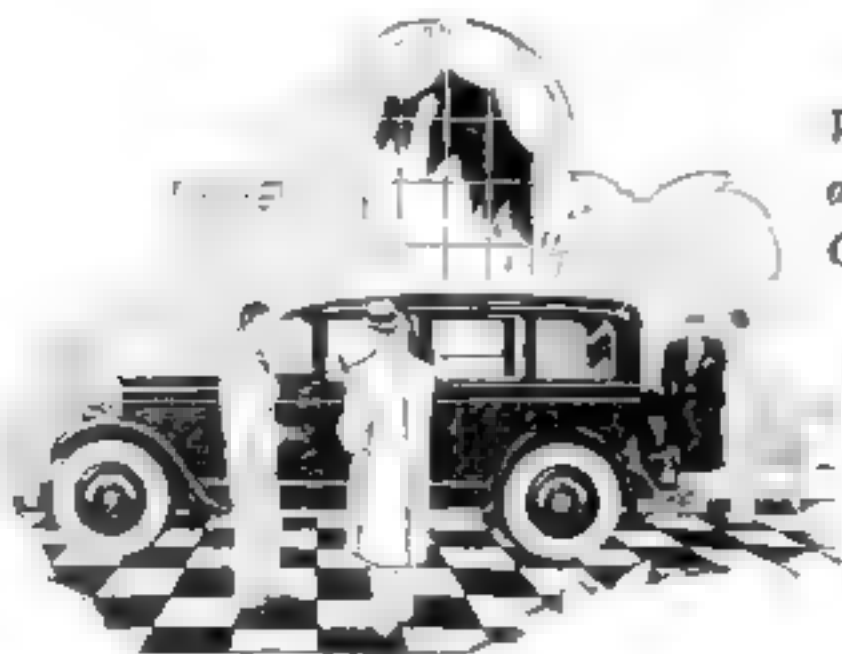
To remove a broken screw it is necessary to gouge out the wood around it, twist it out with pliers, and bore out the gouged place in the wood so that a plug may be glued in the cavity and a new screw driven.

capable of causing all manner of annoyance. Before attempting to turn a single nut, squirt a little kerosene on each and leave it a day or so to soak in. Even galvanized iron wash screws rust occasionally and when in this condition can be twisted off. However, a red-hot iron held to the head will loosen a screw.

Brass screws seldom stick, but when they do they usually twist off unexpectedly. In this event cut into the wood alongside the screw until it is possible to grasp it firmly with long nose pliers and twist it out. Bore out the gouged spot, cut and glue in a neat plug and place a new screw. Sometimes it is possible to put in a new screw alongside the old one and plug the hole over the broken end.

Where bolts holding seats and thwarts have become loose in the holes, the holes should be plugged and re-bored or new fastenings made. (A method was given in POPULAR SCIENCE MONTHLY for October, 1927.)

(Continued on page 105)



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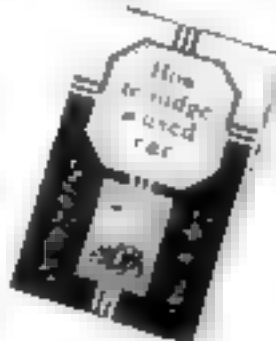
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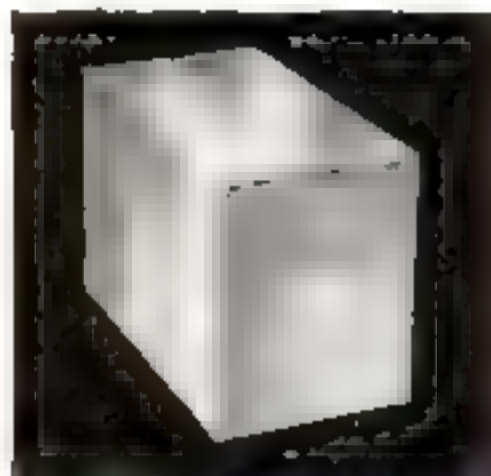
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(Continued from page 82)

and note where holes must be drilled to pass wire underneath the baseboard. The solid lines in the diagram represent wires above the baseboard and the dotted lines the wires beneath it. Remember that you are dealing with voltages that run somewhat over 200, so be careful to see that all wires are carefully soldered and that the insulation is not damaged.

Be sure to twist the leads carrying the low voltage filament current together as indicated.

No other special instructions are necessary. Simply follow the diagram and carefully check each wire as you put it in to be sure that you are right.

A socket is provided in the case of the filament heating transformer B so that the plug from power unit A can be pushed into it. Transformer B is provided with two twisted cords. One is connected to a plug, which is to be inserted into the most convenient light socket, and the other ends in a panel mounting type of toggle switch. This cord is long enough so that, if desired, you can mount this switch on the panel of the electric set or in the side of the console cabinet. This switch controls the entire electric receiver, as snapping it on allows current to flow through the filament transformer B and by way of the socket in B to power unit A.

Separate binding posts are not provided for the 2½-volt and 1½-volt leads from the electric set because these leads can be clamped under the proper binding posts on filament heating transformer B. Each 2½-volt binding post holds two wires, one that goes up to the set and

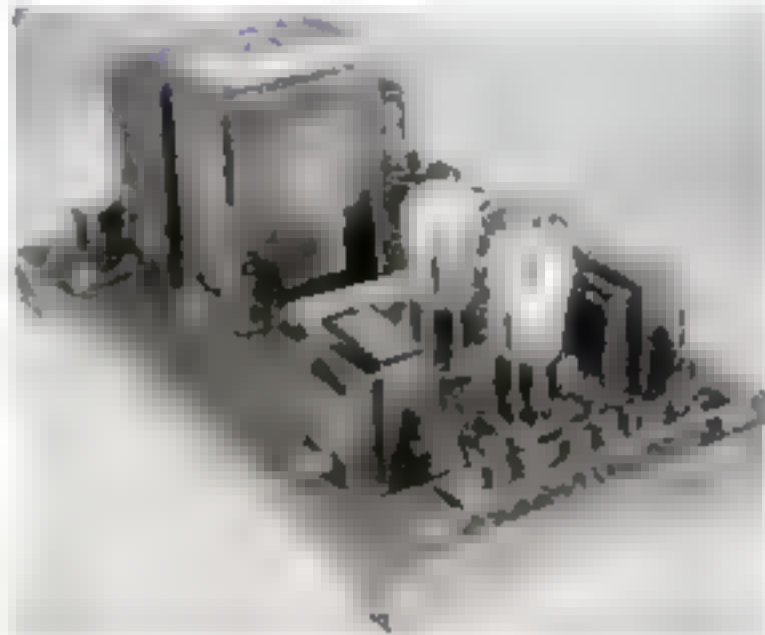


Fig. 3. Two crospieces are used under the baseboard. Fixed resistances R1 and R2 should be supported about 15 in. above the baseboard by passing a long No. 6-32 machine screw through the baseboard and locking the resistances at the desired height by nuts on the screw.

another that goes to potentiometer R2. Use lugs on the ends of wires, therefore, to make sure of a solid connection.

Three binding posts on power unit A are left unconnected. They are the terminals and center tap of a 5-volt winding that is not used in this circuit.

In the usual B-filter circuit, it is customary to arrange the condensers in the 2, 2, 8 order. It will be found that the arrangement used in this circuit in which the 8-mfd. section of the condenser block is placed in the center, gives less hum and better voltage regulation for the power tubes in the push-pull stage.

Do not forget to ground the cases of power unit A, transformer B and condenser block C. This means that you are to bare the end of a piece of wire and clamp it under one of the screws that holds each of the three instruments to the baseboard. The other end of each of the three wires should be connected to the wire that goes to the binding post marked MINUS-B.

Resistance R1 is connected with one end to the minus-B wire and the other end to the wire from the binding post marked 2 on power unit A. The detector voltage is taken off at 5000 ohms from the minus end (the second tap). The 10-volt binding post is connected at the 8000-ohm point (the third tap) and the plus-B terminal of input transformer D1 is connected at 11,000 ohms (the fourth tap).

When you have finished the wiring and have checked each connection at least twice to make doubly sure that you have made no mistakes, you can proceed to mount the amplifier and current supply unit in the lower compartment of a console cabinet with the electric set of Blueprint 79 mounted in the upper compartment. Of course, it is not

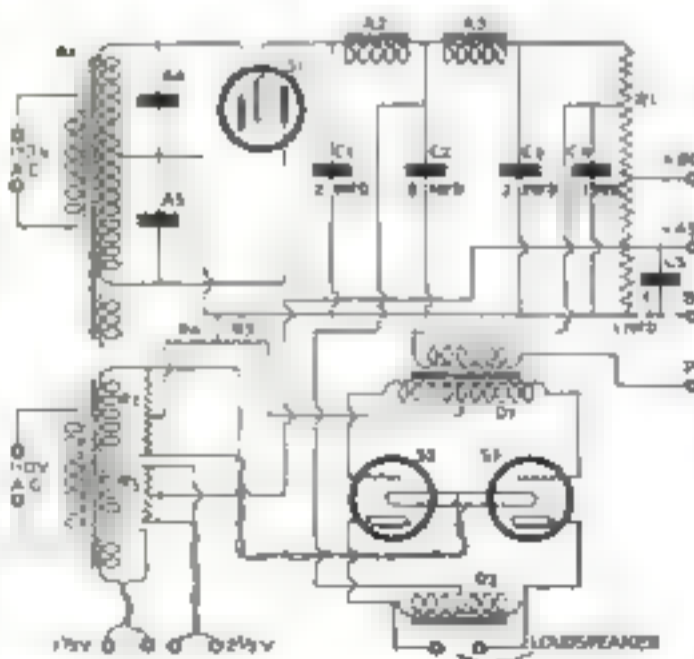


Fig. 4. This theoretical wiring diagram shows the internal circuit of the power unit A. Note that a socket in the case of filament transformer B accommodates the plug from power unit A so that both units are supplied with current from the plug on the cord connected to B.

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Restoring Old Furniture

How to Preserve the Original Wood—Worn Drawers—Clamps—Blind Nailing

By R. C. STANLEY

BEFORE taking up the repair of old furniture, it might be well to explain what constitutes an original antique. It is, in a general way, anything at least 100 years old and ninety percent original. Our Government recognizes an antique, and allows to enter the country free of duty, anything shipped from abroad that can be proved, to the satisfaction of the customs officials, to be more than 100 years old.

Collectors of antiques who are particular in regard to their purchases are very careful to buy nothing that is more than ten percent restored. This rule applies to American antiques as well as foreign. So, according to this standard, a piece of furniture 130 or even 200 years old, if more than ten percent renewed with material not in its originality, is not entitled to be called antique.

The original size and shape must be also considered. One may have, for example, a corner cupboard or a secretary with a straight molding at the top and plain feet under it and replace the straight molding with a broken arch top, and the plain feet with more elaborate ones. The piece in its original form may have been centuries old, and probably the changes and replacements made do not affect more than two or three percent of the whole. But the design has been changed, so in its new form the age dates from the time the changes were made, and to all intent and purposes it is a secondhand piece of furniture.

ANYTHING in which the design or size has been changed is not an antique, not even 100 years or more after the changes are made, for it can never again be original. To substitute wood panels for glass, or glass for wood, drawer handles for knobs, or knobs for handles; to change the number of panes of glass in a door, say from eight or ten to thirteen—any of these slight changes destroy the originality of an antique and prevent its ever becoming valuable as an antique.

A lady of the writer's acquaintance bought a very fine old snake-foot round table (commonly called candlestands by those who don't know the difference). Two of the feet were split, but could be glued back and the piece would have

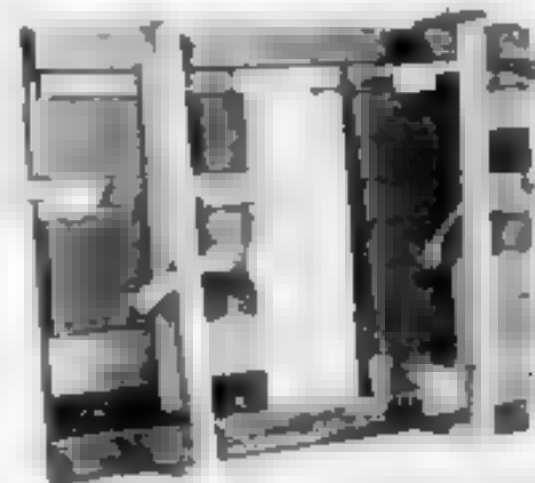


Fig. 1. A framework of rough boards made as shown in Fig. 4 (page 117) is used for clamping furniture parts that have been glued. Note the cross members, which keep the work flat.

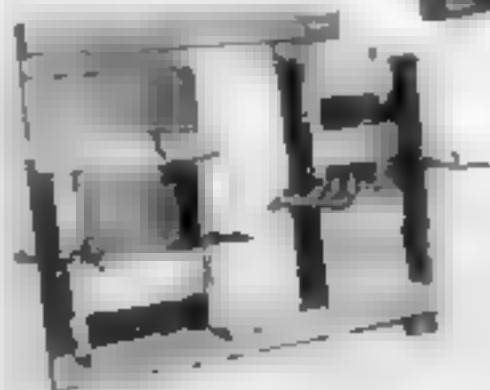


Fig. 2. A similar frame with iron C clamps instead of wooden wedges for applying pressure to keep boards flat.

been 100 percent original. It was undoubtedly many years past the 100 mark, but the lady insisted that the repair man make two new feet and discard the damaged ones.

He went ahead according to instructions, but before he had progressed far the lady returned to say that she did not like the design of the turned post. "Couldn't he make her a new post, turned to her own design?" Sure! So a new post was turned, but then she decided the top was not large enough for the spread of the feet. "Couldn't she have a new top a little larger?" She got it! The table can't be regarded as a year old yet, but the lady boasts of her "antique" candlestand she "bought up in the mountains."

The repair man had more than ninety percent of the table left on his hands. He made one new foot, repaired the two damaged ones, reassembled the table, and sold it as an original antique table, which it was, without question.

All this is to warn against changes which destroy originality. You can't possibly have antiques made to order. Of course, where several are missing and can't be duplicated, wood knobs may be changed for glass knobs and vice versa, or one design of handles may be changed for another, but wherever possible to do so, every part of the piece that is original should be preserved, although to preserve it may take much more time and work than to replace it with new material. The (Continued on page 117)

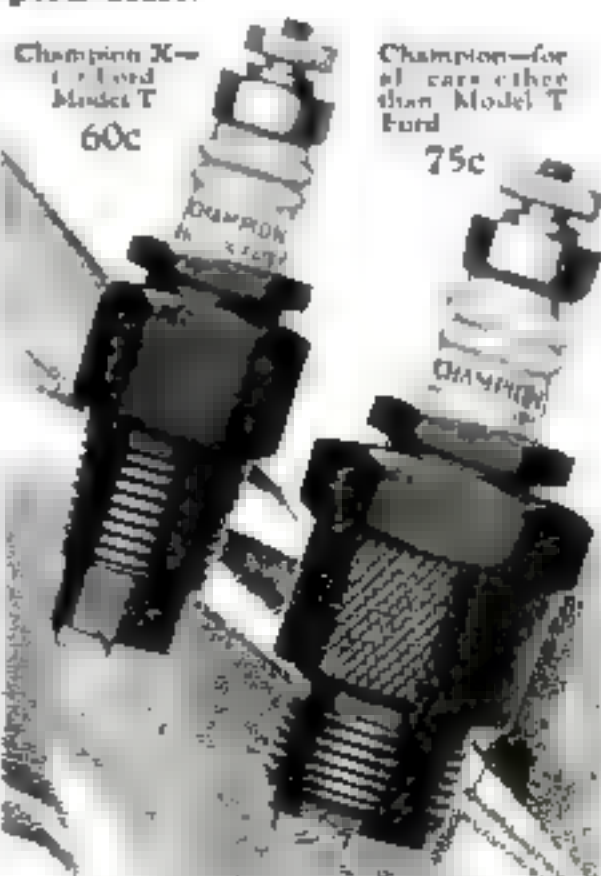
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A Real Kiddies' Playground

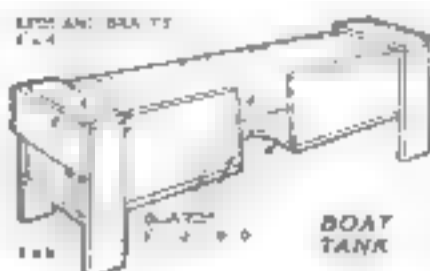
(Continued from page 79)

them. Merely widen the end link of each chain, slip it over the end and bend it back in the groove.

For the rings cut two pieces of chain 32 in. long and two pieces 7 in. long. Join these to form a V. Next take one of the 5-in. bolts, slip a $\frac{1}{2}$ -in. washer over it and put it through one side of the chain. Slip the bolt through one of the 4-in. lengths of gas pipe and out on the other side of the chain; add another washer and the nut. In finishing the apparatus, you can use either white paint or spar varnish.

The boat tank is so simple in construction that it is hardly necessary to go into any details. The materials necessary are 3 pcs. 1 by 12 in. by 8 ft., 1 pc. 1 by 12 in. by 2 ft., 1 pc. 1 by 6 in. by 3 ft. and 1 pc. 1 by 4 in. by 8 ft., yellow pine or cypress.

Square up the 1 by 12 by 8 ft. pieces and plane to a smooth edge. Cut the two



Be sure that the edges of the boat tank boards are heavily coated with white lead before being nailed together. This will be of help in making the joints water-tight.

ft. yellow pine, 1 pc. 1 by $1\frac{1}{2}$ in. by 10 ft. oak, 1 pc. 2 by 4 in. by 3 ft., yellow pine; 8 pcs. $\frac{1}{2}$ by 1 in. strap iron, 18 in. long; 1 set of porch swing chains; 4 screw hooks, 1 in.; 2 disk wheels, 5 in.; 100 ft. No. 8 galvanized wire; 2 pulleys, $1\frac{1}{2}$ in.

The wing, which is 4 ft. from tip to tip, and the fuselage, which is 4 ft. 3

in. long, are cut from 12-in. board. Join the wings and fuselage with $1\frac{1}{2}$ -in. wood screws. Cut an 18-in. piece of two-by-four and fasten it to the bottom of the fuselage or body directly under the wing to form the axle or landing gear. To this attach the wheels next. If you can't obtain disk wheels conveniently, saw out wheels of 1-in. oak. Be sure the landing gear and wheels are strongly made. There is considerable strain on these parts when the ship lands. Fasten the two pieces of 1-in. strap iron in place to brace the landing gear.

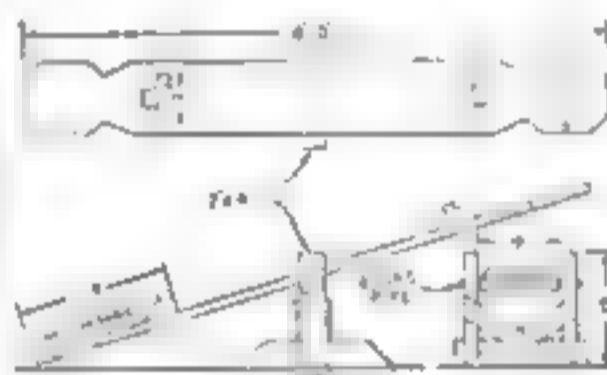
The tail skid is made of two 15 in. long pieces cut from 1 by $1\frac{1}{4}$ in. oak and bolted in place on the fuselage. As this is used as a brake in stopping the airplane, be sure that it is firm.

You will notice in the drawing that the fuselage also is reinforced with 1 by $1\frac{1}{4}$ in. strips. Cut two pieces 14 in. long and fasten them on each side of the fuselage in back of the seat. They extend about 2 in. above to give a place for attaching the rear chain. Bolt two pieces of wood 12 in. long between the axle and the wing just ahead of the cockpit.

The seat is made of any light wood and cut as shown in the drawing. The tail is made of two pieces 1 by 3 by $8\frac{1}{4}$ in., cut as shown, and nailed in place. The radiator is a piece of oak 1 by $1\frac{1}{4}$ by 6 in., held in place with two screws. The propeller is cut from white pine and pivoted on a 2-in. wood screw.

A porch swing chain set usually contains two large hooks, these are screwed into the 2 by 4 in. axle for the two front end chains.

(Continued on page 100)

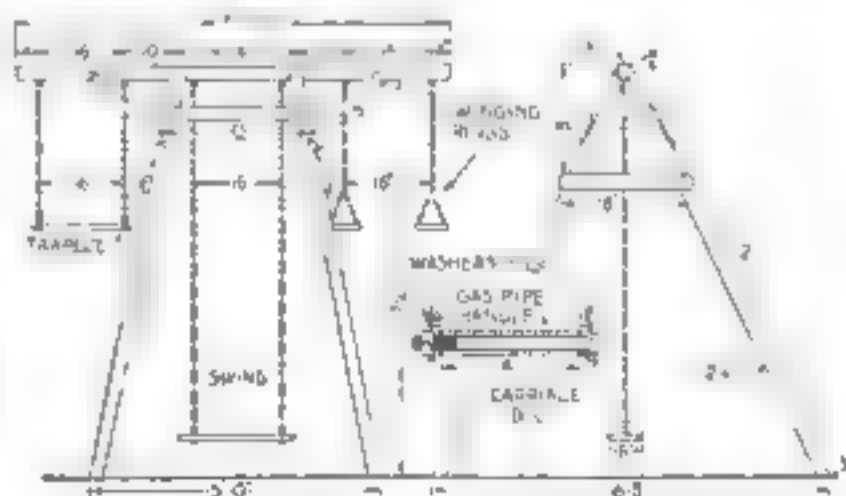


Make sure that the gas pipe shaft cannot work out and allow the tentier totter to spill the children. Two cotter pins will prevent that.

ends $10\frac{1}{4}$ by $11\frac{1}{4}$ in. and nail ends and sides together. Now take the other 8-ft. board and nail it in place for the bottom. It is well to put a heavy coat of white lead on the edge of the sides and ends before the bottom is nailed in place. This will insure a more waterproof tank. Next cut four 1 by 4 in. pieces 10 in. long and nail them on the four corners to form the legs. Cut a 1 by 4 in. piece to fit across the top of the tank at each end to reinforce it and keep it from spreading. Cut two 1 by 8 in. pieces and nail in place across each end at the top. Bore a 1-in. hole 1 in. from the top to keep the tank from overflowing.

While the construction of the airplane is comparatively simple, it must be built up properly or it will be dangerous for the smaller children. The landing gear and tail skid must be strongly built so that the plane will not be broken when it lands.

The materials necessary are: 1 pc. 1 by 12 in. by 12



The frame for the wing, tail and rings is made from planed lumber bolted together. Porch swing chains and hooks are used.

A Real Kiddies' Playground

(Continued from page 86)

In painting the airplane you can use any colors you desire. The one illustrated is white, with red, white and blue targets on the wing and a black radiator.

The trolley is made of a piece of 1 or 1½ by 1½ by 16 in. oak. Screw two hooks above and two on the underside. Slip the pulleys in place and, to make certain they will not come loose, bend shut the hooks that hold them. The lower hooks are left open so that the chains can be adjusted to the desired height.

Now comes the most interesting part of the whole job—making ready for our test flight. Take 100 ft. of No. 9 wire, slip the pulleys into position, and stretch the wire from the house to the garage, or to a tree or any other suitable place. It is not necessary to have the upper end to any great height, a very small incline will give sufficient speed to thrill any youngster. After the wire is stretched, fasten the airplane to the hooks and adjust it so that the tail skid will come in contact with the ground before the wheels touch. This will bring the airplane almost to a complete stop before it reaches the lower end of the wire. It is well to use a turnbuckle at one end of the wire, as from time to time it will be necessary to take up the slack.

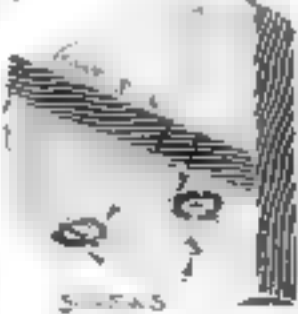
The teeter-totter is a very simple piece of apparatus, but it will give the children endless pleasure. The materials: 1 pc. 1 by 12 in. by 8 ft., 1 pc. 2 by 4 in. by 12 ft., and 1 pc. 1 by 4 in. by 8 ft., yellow pine; 1 pc. of ¼-in. gas pipe (about 1 in. outside diameter) 24 in. long.

First cut out the 1 by 12 in. by 8 ft. board as shown in the drawing on page 98. Nail or screw across the board at the center one piece 2 by 4 by 17 in., after boring a 1-in. hole through it from end to end. Cut two pieces for uprights 2 by 4 by 19 in. long and 5 in. from the top of each bore a 1-in. hole. Cut two pieces 2 by 4 by 27 in. to form the base and nail them in place as shown. Cut one piece of 2 by 4 by 18 in. and nail it between the uprights at right angles with the base. Now brace the stand with two 1 by 4 in. pieces as indicated in the diagram. Place the top board in position and slip the pipe through the uprights and through the hole in the cross member, cotter pinning it in place. The handles are made of 1 by 1 by 7 in. pieces with a small block of 2 by 4 in. as the base.

Screw Eyes Serve as Neat Supports for Shelves

WHEN it is not convenient to use regular shelf supports, screw eyes often will serve in their place. Small shelves can be rested on the screw eyes just as on regular shelf supports, but large shelves can be held by driving short screws up through the screw eyes into the wood as shown.

SCREW EYES



A shelf fastened with screw eyes and screws

The finest tool of its kind

Try This Test

Put Auger Bit into chuck of Yankee Ratchet Brace deep into tough wood. Then pull upward with all your strength. Bit will not come out of chuck.



Guaranteed by the name "YANKEE"

See this wonderful "Yankee" Ratchet Brace at your hardware dealer's. Like all "Yankee" Tools it saves time and labor. Try it and you will appreciate the economy of paying a little more to own the finest tool of its kind.

For No. 2100 is made and finished like a precision tool. The famous "Yankee" Ratchet is smooth, powerful, silent, as smooth-working as the stem-wind of a watch—yet unbreakable. No need to hold chuck to keep it from turning back on ratchet movement.

A finger touch on easy-acting Ratchet Shifter gives right or left ratchet, or rigid. Positive visible adjustment. Dust-proof. Moisture-proof.

Price (16-inch sweep) \$4.75

NEW "Yankee" Chuck—most efficient ever made. Ball-bearing, quick centering, and accurate. Holds any bit round, square, any taper; in vice-like grip. Yet chuck releases bit at a turn of wrist.

Handles are hard rubber and telescopic. Top handle steel ball-bearing. Swee handle case held by patented "Yankee" method, preventing cases or handle from slipping. Chuck is finished optically in keeping with its perfect mechanism.

"Yankee" Bit Extension No. 2150

Price (18-inch) \$2.50

Stands above and follows through. Bit held by socket. No jaws to break. No loosening and pulling out of bit in work. And bit in "Yankee" Socket can't jam. Fits any brace. Lengths: 12, 18, 24, 36 inches. Holds large range of bit shanks.

"Yankee" is the tool you buy once and the answer in quality, efficiency and durability.

Write for FREE "Yankee" Tool Book. Phone how "Yankee" Tools make work easier: Spiral Screw-drivers, Plain Screw-drivers, Automatic Push Drills, Ratchet Braces, Hoes, Chains, and Bench Tools, Ratchet Tap Wrenches. Also with removable base, etc.

Dealers Everywhere Sell "Yankee" Tools. NORTH BRON. MFG. CO., Philadelphia, U.S.A.

"YANKEE" TOOLS

Make Better Mechanics

Furniture for Beginners

(Continued from page 100)

Perhaps the most popular finish at present, and certainly one of the easiest for the home worker to apply, is that obtained with quick drying brushing lacquers. The original pieces were given two coats of jade green lacquer and decorated with Chinese red, applied through a simple stencil.

To make a stencil, draw the designs shown or other suitable designs on oiled paper and cut out the pattern with a sharp knife or razor blade. If the back of the stencil is covered with paste, it will adhere closely to the surface being decorated and no color will creep under. When the lacquer is dry, the stencil can be peeled off and any small pieces which stick may be removed by rubbing gently with a wet rag.

Transfer (decalcomania) designs could be used instead of a stencil.

If one of the new lacquer hand sprayers is purchased, the lacquer can be sprayed on and blended effects may be obtained.

A finish that will preserve the original beauty of the wood can be produced with a coat of stain and two coats of shellac rubbed with No. 40 or other very fine sandpaper or steel wool and finally polished with furniture wax. If a water stain is to be used, wet the table thoroughly with clean water before staining and when perfectly dry smooth the wood with No. 00 sandpaper, using the hand only, not a block, to cut down the raised grain.

To make the night table which is

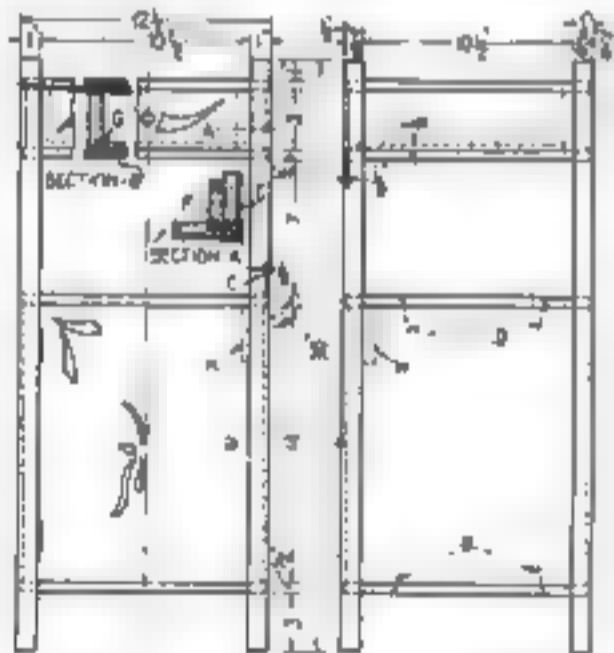


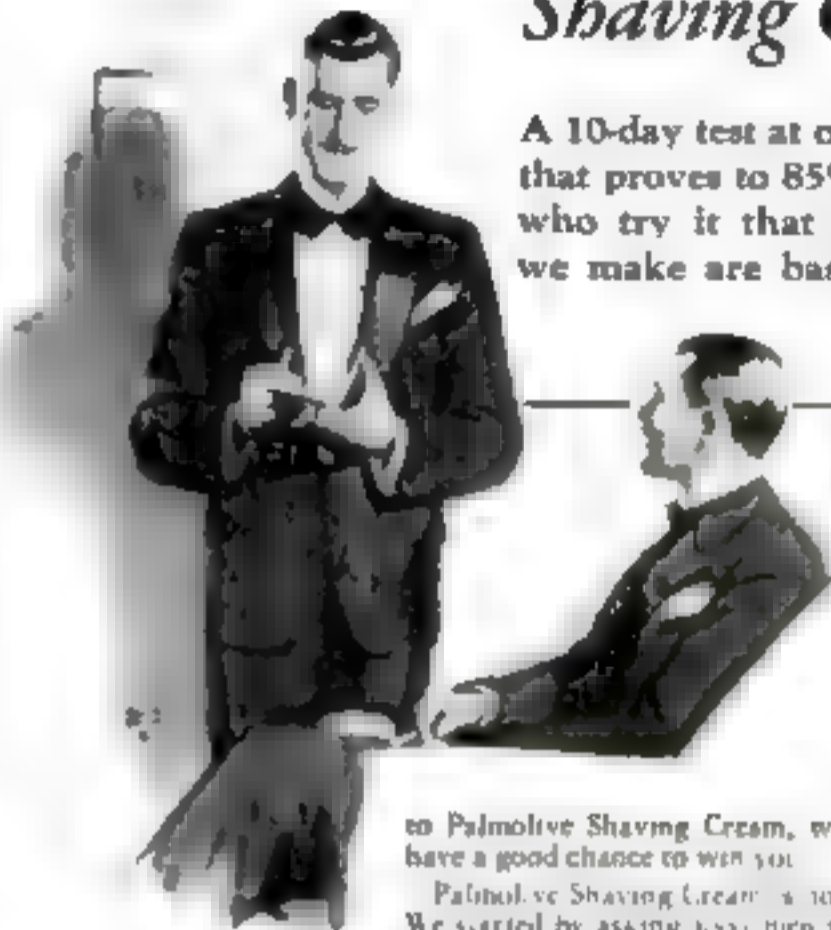
Fig. 4. Front and end views of the night table and sectional details of the drawer

shown in Figs. 3 and 4, purchase boards from which the following pieces may be cut economically, or take the list and Fig. 4 to a lumber mill to have the stock worked to the given dimensions: 4 legs, 1 by 1 by 30 in.; 4 shelves, $\frac{1}{2}$ by $12\frac{1}{4}$ by $12\frac{1}{4}$ in.; 4 sides and door, $\frac{3}{4}$ by $10\frac{1}{2}$ by 14 in.; 4 sides and drawer front, $\frac{3}{4}$ by 8 by $10\frac{1}{2}$ in.; 2 (Continued on page 103)

How We Win Men

To Our New Shaving Cream

A 10-day test at our expense that proves to 85% of those who try it that the claims we make are based on fact



to Palmolive Shaving Cream, we feel we have a good chance to win you.

Palmolive Shaving Cream is no accident. We started by asking men what they most desired in a shaving preparation. Then set out to give it to them.

Formula after formula failed in the complete result—129 in all! Then success came. Our great laboratories, skilled for 60 years in soap supremacy, had created another leader.

These 5 things you wish

1. Multiplies itself in rather 150 times.
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face.
4. Strong bubbles hold the hairs erect for cutting.
5. Fine after-effects due to palm and olive oil content.

Now mail the coupon

We take the risk—not you. We undertake to please you—to win you in ten shaves. Won't you mail the coupon, please?

GENTLEMEN

No man is ever convinced against his will. And extravagant claims tend to impress when the product itself cannot live up to them.

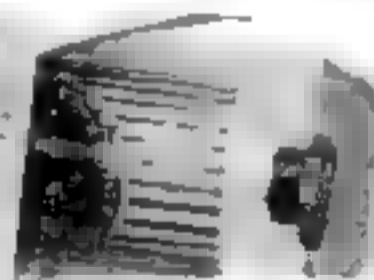
So in introducing our new shaving cream to you we discard bombast and boasting, and rest our case fairly on your decision after you have made a suitable trial of the product itself.

Now we offer you a ten-day test, at our expense. We expect it to prove to you in your own bathroom that this is the finest shaving cream you have ever used. Our whole case rests on *merit alone* convincing you.

We take the risk—not you

If we are right, surely you want to know about it. And, since the big majority of those who make this test become wedded

THE PALMOLIVE SOAP COMPANY, CHICAGO 62, ILL.



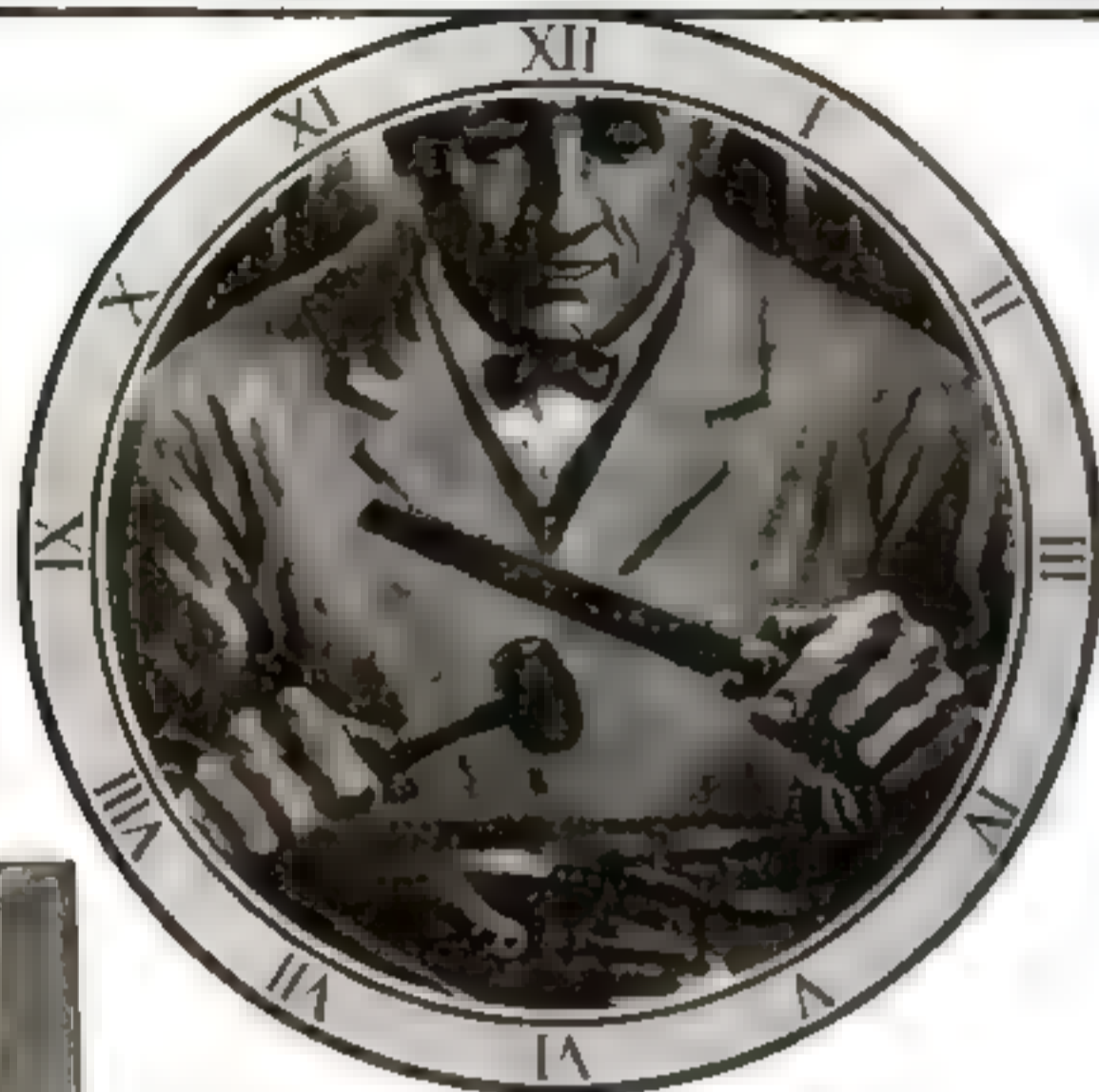
35¢ 3090

10 Shaves FREE
and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1474, Palmolive, 1111 North Dearborn St., Chicago 10, Ill.
Residents of Wisconsin should address Palmolive, Milwaukee, Wis.

(Please print your name and address.)

NICHOLSON FILES *Save Time*



Files Must Be "Handled" Right For Good Work

Files that are improperly inserted in their wooden handles—so that they slip or are out of line—make good filing work difficult.

Here is how the experienced tool user will tell you to "handle" your files: Heat the tang of an old file of the same size as the one to be "handled." Burn out the hole in the wooden handle, taking care that it is "in line." Then drive in the new file up to the shoulder, completely embedding the tang.

One more thing to remember: Before you "handle" the file, look for the NICHOLSON trade mark on the tang.

Good filing work demands good files properly used. Our booklet, "File Philosophy," gives many practical suggestions for better filing. A copy will be sent free on request.



NICHOLSON FILE CO.
Providence, R. I., U. S. A.

—A File for Every Purpose

Blueprints for Your Home Workshop

ANY ONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available.

Popular Science Monthly
250 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I inclose

		dollars	cents
No.	Title	Described in Issue of	Price
1	Sewing Table	Feb., '23	25c
2	Smoking Cabinet	Mar., '23	25c
3	End Table	Apr., '23	25c
4	Kitchen Cabinet	May, '23	25c
5	Arbor Gate and Seats	July, '23	25c
10	Porch Swing	Aug., '23	25c
11	Bench and Tilt Table	Sept., '23	25c
12	Toy Wagon	Nov., '23	25c
14	Christmas Toys	Dec., '23	25c
15	Workshop Bench	Jan., '24	25c
17	Cedar Chest	Mar., '24	25c
18	Phone Table and Stool	Mar., '24	25c
19	Grandfather's Clock	Apr., '24	25c
20	Flat Top Desk	Apr., '24	25c
21	Colonial Desk	Apr., '24	25c
22	One Car Garage	May, '24	25c
24	Gazebos Table	June, '24	25c
25	Cause Bailing Outfit	July, '24	25c
26	Baby's Crib and Bed	Sept., '24	25c
17	Kitchen Cabinet Table	Oct., '24	25c
29	Toy Tea Cart, etc.	Dec., '24	25c
30	Tool Cabinet, etc.	Jan., '25	25c
31	Sewing Cabinets	Feb., '25	25c
33	Dining Armoire	Apr., '25	25c
34	Garden Trellises	May, '25	25c
35	Simple Radio Cabinet	Oct., '25	25c
37	Simplified Bookcase	Dec., '25	25c
38	Small Drop-Land Table	Jan., '26	25c
39	Small Chest of Drawers	Feb., '26	25c
40	Small Drop-Front Desk	Mar., '26	25c
41	One Tube Radio Set	May, '26	25c
42	Three Stage Amplifier	June, '26	25c
43	Four Tube Receiver	July, '26	25c
44	Pirate Ship Model - Hull	Feb., '26	25c
45	Pirate Ship - Details	Mar., '26	25c
46	Galleon Model - Hull	May, '26	25c
47	Galleon Model - Details	June, '26	25c
48	Sailing Yacht Model	July, '26	25c
49	Broom Cabinet	Aug., '26	25c
50	Airplane Model (Flying)	Sept., '26	25c
51	Clipper Ship Model - Hull	Oct., '26	25c
52	Clipper Ship - Details	Oct., '26	25c
53	Clipper Model - Rigging	Nov., '26	25c
54	Five Tube Radio Set	Oct., '26	25c
55	Five Tube Set - Details	Oct., '26	25c
56	Bird and Animal Toys	Dec., '26	25c
57	Constitution Model - Hull	Jan., '27	25c
58	Constitution - Rigging	Feb., '27	25c
59	Constitution - Rigging	Mar., '27	25c
60	Welsh Dresser	Mar., '27	25c
61	Viking Ship Model - Hull	Apr., '27	25c
62	Viking Ship - Details	Apr., '27	25c
63	Toy Motor Boat - Hull	May, '27	25c
64	Toy Motor Boat - Details	May, '27	25c
65	Big Simple Block Puzzle	June, '27	25c
66	Ship Model Weather Vane	Aug., '27	25c
67	Toy Model of Lindbergh's New York to Paris Plane	Aug., '27	25c
68	Magazine Rack Table and Book Trough Table	Sept., '27	25c
69	Flying Model 3 ft. of Lindbergh's Monoplane	Oct., '27	25c
70	Console Radio Cabinet	Nov., '27	25c
71	Console Cabinet - Details	Nov., '27	25c
72	Doll's House	Dec., '27	25c
73	Doll's House Furniture	Dec., '27	25c
74	Santa Maria Model - Hull	Dec., '27	25c
75	Santa Maria - Rigging	Feb., '28	25c
76	Santa Maria - Details	Jan., '28	25c
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80	High Power Unit for Electric Radio Set	Mar., '28	25c
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82	Simple Single Stick Airplane Model 30-in.	Mar., '28	25c
83	Mayflower Model - Hull	Apr., '28	25c
84	Mayflower - Details	Apr., '28	25c
85	Mayflower - Rigging	Apr., '28	25c

Name
(Please print name and address very clearly)

Street

City and State

Furniture for Beginners

(Continued from page 101)

drawer sides, $\frac{1}{2}$ by $2\frac{3}{4}$ by $10\frac{1}{4}$ in.;
1 drawer back, $\frac{3}{4}$ by $2\frac{3}{4}$ by $9\frac{1}{2}$ in.;
1 drawer bottom, $\frac{3}{4}$ by $10\frac{1}{4}$ by $10\frac{1}{4}$ in.

When all pieces have been cut and squared, place the four shelves together with corners and edges coinciding and fasten with $\frac{1}{8}$ -in. brads (not more than three or four to each piece) driven near the corners, or hold the bunch together with hand screws.

WITH knife marks lay out accurately the corners that are to be cut out to fit the legs, square across the edges and the surfaces of the shelves. Be sure that the $10\frac{1}{4}$ in. between the shoulders is correctly marked. Cut with a fine saw.

Plane and sandpaper all outside surfaces. Place the three $10\frac{1}{4}$ by 14 in. sides between the two lower shelves, setting them back from the edge of the shelf $\frac{1}{2}$ in. as at C. Nail through the shelves into the ends of the sides as at D with $1\frac{1}{2}$ in. No. 16 brads, being sure the edges of the sides coincide with the cuts in the corners of the shelves. Repeat this process with the two top shelves and the three 8 by $16\frac{1}{2}$ in. sides. Assemble the legs and all the shelves by nailing as at E with six-penny finishing nails, first drilling through the legs. The inside of the sides and the legs should be flush.

The back of the drawer front should be cut out at each end to receive the drawer sides as at F of section A and a rabbet cut at the bottom $\frac{1}{4}$ by $\frac{1}{2}$ in. to receive the $\frac{1}{4}$ -in. drawer bottom as at G of section B. Assemble the drawer by fastening the sides to the back and front with $1\frac{1}{2}$ -in. brads, keeping the lower edge of the sides flush with the rabbet of the front and with the bottom edge of the back. Fasten the $\frac{3}{4}$ in. bottom to the sides and back with 1 in. No. 17 brads. Fit the drawer so that it will slide easily, touching the sliding surfaces with a wax candle or soap will help. Place a brass knob in the center of the front.

Hang the door with $1\frac{1}{4}$ -in. medium brass butt, fit a small cupboard lock or catch, make a door stop $\frac{1}{4}$ by 1 by 8 in. and brad in place at H.

The construction of the smoking stand, Fig. 3 is

(Continued on page 103)

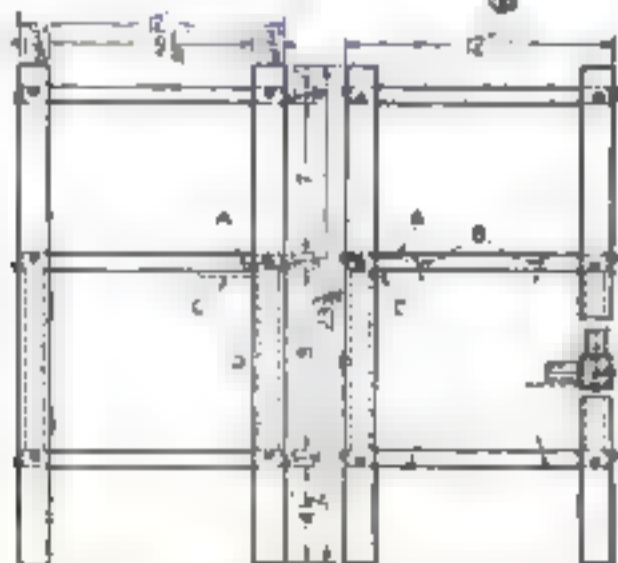


Fig. 3. The smoking stand may be assembled with nails or screws in the easiest way



"KYANIZE makes the old like new. I have used KYANIZE to renovate my house, with wonderful results. KYANIZE is ideal for the walls and floor enamel for the floors. They make the old as bright and beautiful as the new." J. Thornton, Calgary, Alberta, Canada.

From Kitchen to Attic *Kyanize* Brightens and Beautifies

Keep your home charming and attractive with KYANIZE Floor Finish. This easily applied economical finish is ideal for furniture and woodwork as well as for floors. It is transparent, yet it comes in several beautiful shades from Light Oak to Dark Mahogany, as well as in the 'clear' or natural. In applying KYANIZE Floor Finish you need not even stir it. Simply brush it on. It dries overnight brilliant and smooth and even.

KYANIZE Ideal Transfers, fully described in our book, "The Charm of Painted Things," add the final touch of beauty to articles refinished with KYANIZE. These exquisite floral and silhouette decorations can be applied in a minute or two by just slipping them off the moistened paper directly onto the surface you have finished. Send 10 cents for our new booklet "The Charm of Painted Things."

Special \$1.00 Offer: If your dealer cannot supply you send us his name and ONE DOLLAR and we will forward, charge prepaid, a full pint of KYANIZE Floor Finish and our new Instruction Book, "The Charm of Painted Things"—all for \$1.00. Mention color desired: Light Oak, Walnut or Brown Mahogany, Dark Oak, Mahogany, Golden Oak, Colonial Green, Cherry, Natural or Clear, Rosewood or Dark Mahogany.

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Kyanize

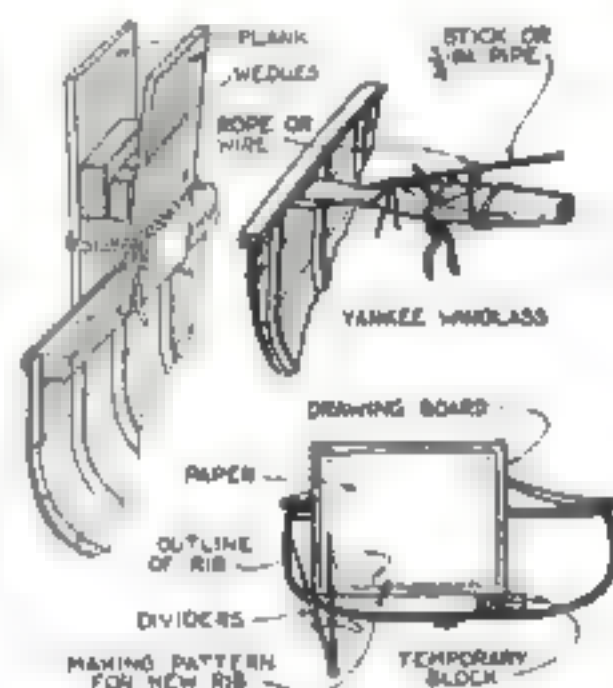
VARNISHES & ENAMELS for Floors-Furniture-Woodwork

Repairing Canoes

(Continued from page 84)

Large splinters broken from the wales are often lost, and it then becomes necessary to inlay another piece to fill the depression. Work out the gouged place to geometrical dimensions with smooth surfaces against which to glue the inset wood, cut, file and sandpaper a piece of similar wood to fit the prepared faces but leave it somewhat oversize as to its other dimensions, glue it in place, clamp or tie it firmly and, when the glue has set, plane, file and sand the inlay to an even surface. If the outside of the inlay were made to fit exactly at first, it probably would be damaged when clamped.

It is usually possible, and in most cases desirable, to hold such pieces in place by tying and then tightening the lashing, if



Two methods of clamping cracked parts together and how to make a rib pattern

necessary, with a Yankee windlass as shown, but sometimes this is not feasible and a board clamp is better. Tie loosely face to face two pieces of board at least $\frac{3}{4}$ by 6 by 24 in. The turns of rope or wire should be 6 in. from one end. Apply glue to the patch or break, adjust the short end of the clamp to hold the work and spread the long end of the clamp by driving one or more wedges. It is possible to crush the wood or to squeeze all the glue out of the break with this very powerful clamp, so be cautious. The clamp can be used in the most inaccessible places by shaping the ends as necessary.

All glue used in canoe work should be of the waterproof variety and, as there are numbers of these, the instructions of the manufacturer should be followed.

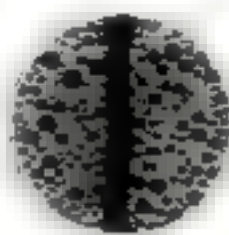
When the ribs, planking and hardware have been attended to, it is time to replace the canvas. Measure across the hull amidships. This dimension represents the extreme width of the piece of 8-oz. canvas needed for the covering. It may be brown or white, provided that it is of good close weave and one piece from end to end.

Remove the outer stems, or bang-plates, and the keel, if there is one. Coat the entire hull with marine glue laid on hot, and, when the glue hardens, stretch the canvas along (Continued on page 146)

Off...come Whiskers Smooth and Clean

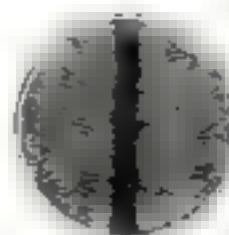
when beard is softened at the base

... Small Bubble Way ...



ORDINARY LATHER

Photomicrograph of ordinary lather surrounding ing angle hair. Note how the large bubbles hold air instead of water against the beard.



COLGATE LATHER

Photomicrograph of Colgate lather surrounding ing angle hair. Note how the small bubbles hold water instead of air against the beard.



Bill Ray knew when he wanted! Asks for Small Bubble Lather... and he got it! Yes! He got it! Not on his life! There's a small bubble lather...



Now I am glad with Colgate... work it soft with water.

Instantly your beard gets moist and pliable... damp and lifeless... scientifically softened

right down at the base... ready for the razor.

Thus your whiskers come off clean and smooth. No razor-pull. No stinging and smarting. Twice-over shaves aren't needed now. Your face feels clean, fresh, smooth, invigorated.

Please don't confuse Colgate's with ordinary shave preparations. Once you try it, you'll see the improvement over old-fashioned methods. You've never had a shave like this before. You've never known such comfort... never known such smoothness in all your shaving days.

You be the judge... for seven days

We'll gladly send a seven-day trial tube of Colgate's in any far-minded man. Compare it with the shaving cream in your bathroom now.

As an extra dividend we will also send you a sample box of Colgate's Talk for Men. Just try it after shaving.

HERE'S a smoother shave now! Here a speed and comfort too.

A new type of lather, that soaks whiskers soft in a strictly scientific way—a lather that makes shaving serene and comfortable without razor-pull, sting or smart.

The secret? Small bubbles. And oh, what a difference they make!

Your face feels clean... delightfully refreshed. You can sense the difference instantly... see it in your mirror. "Makes your skin feel smooth as velvet"... that's what thousands tell us.

Now, to introduce this Colgate product to men who haven't tried it, a test is being offered. See complete details in coupon below.

Colgate lather is designed to absorb more water... to scientifically drench your beard with moisture right at the whisker base, where the razor work is done.

You'll see the difference quickly

It's a "small-bubble" lather. For small bubbles hold more water. They carry it closer to the base of your beard.

A glance at the photographs above proves this better than words. Note how the large, air-filled bubbles of ordinary lather fail to settle close to the whisker.

Now contrast them with the closely knit, moisture-laden Colgate bubbles packed close around the whisker.

The minute you lather up with Colgate's, two things happen—

1. The soap in the lather breaks up the oil film that covers each hair... floats it quickly away.

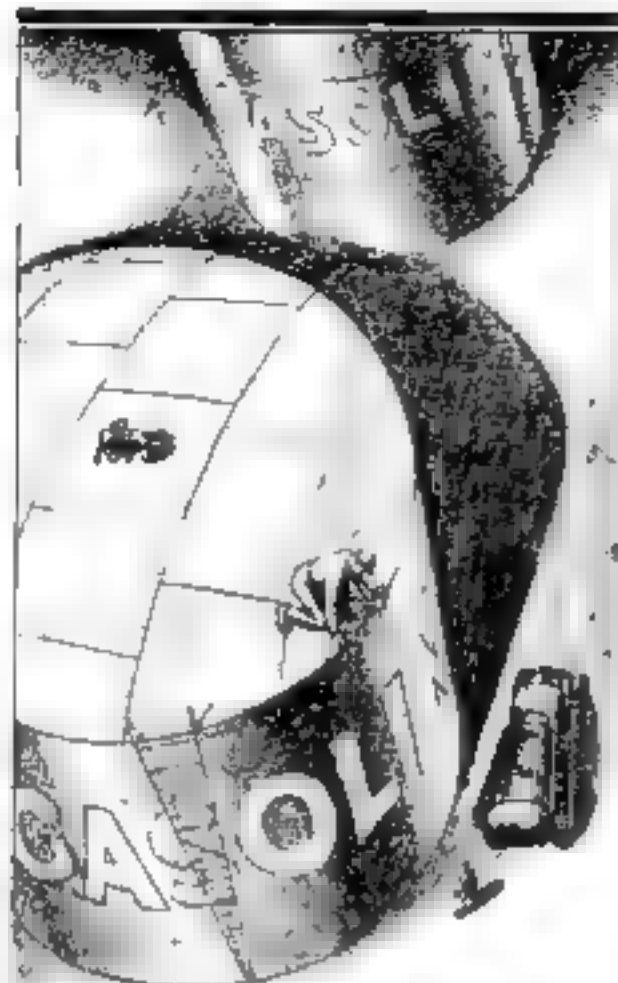
2. Then balloons of tiny, moisture-laden bubbles seep down through your beard...



Colgate & Co., Dept. 344-D, 145 Fifth Ave., New York. Please send me FREE sample of Colgate's Rapid Shave Cream. Also sample of Colgate's Talk for Men.

Name...

Address...



Get a Move On down there— Send Up A TRIMO



To do pipe work quick and do it right there is no wrench like a TRIMO. Pipes move and move fast when TRIMO grips them. TRIMO jaws will always hang on. New ones can be inserted when the old

ones are worn.

TRIMO all-steel construction won't break under the hardest usage. TRIMO nut guards save precious time by keeping the adjustment true. At your hardware dealer's ask for a TRIMO, not merely "a pipe-wrench."

When you want a pipe wrench, buy a TRIMO

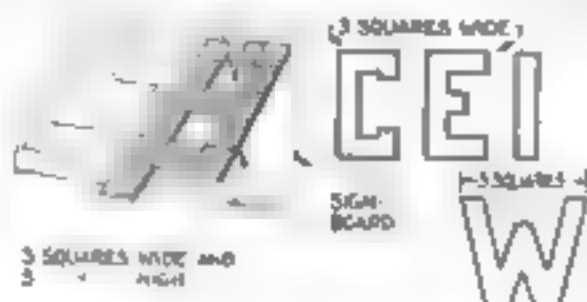
TRIMO

TRIMONT MFG. CO., Inc.
Roxbury, (Boston), Mass.
For Forty Years the Leading
Wrench Makers of America

Template for Block Letter Signs

EVEN if you have had no experience in sign painting, you can make presentable block letter signs or cut neat stencils with the aid of a sheet metal or cardboard template made as illustrated.

The letters are made five squares high; the extra square on the template is to give a place to hold it down while drawing around it and also to provide a long edge



This metal or cardboard template speeds up the laying out of well-proportioned letters

for ruling the diagonals of "N" and similar letters.

In width the letters vary between "I" which is one square, and "W," which is five squares. The letters are ordinarily spaced one square and words two squares apart but some adjustment should be made to give the appearance of uniformity that is, combinations like "IA" which are open in appearance should be placed as close together as possible, whereas "WH" which has a solid, tight look should be spread apart a full square or even a little more. Speed in using the template is quickly gained by practice.

Repairing Canvas Canoes

(Continued from page 105)

the hull, its center over the keel marks. Tack it there with copper tacks every few inches. Work each way from the midship section, first on one side and then on the other, and stretch and tack the canvas at the wales.

To insure a close fit near the ends, it may be necessary to wet the covering in places and exercise a little patience. When the canvas is thoroughly dry, go over the hull inch by inch with a moderately hot flatiron so as to bring the glue up through the pores of the cloth.

It is a wise precaution to give the hull two coats of shellac before painting, as this prevents the glue from "bleeding" through the color in hot weather. After this the keel, stems, and outwales may be replaced.

Patching damaged canvas is a much easier matter. Work up the edges of the rent with a knife, run in glue and slip in a piece of droling or unbleached muslin large enough to cover the hole. Put more glue on this and, after trimming off any loose threads, press the canvas back in place, holding it with thread if necessary. Rub a flatiron, or other smooth weight, with paraffin to keep it from sticking to the glue and set it on the patch.

In another article scheduled for early publication, Mr. Hazard, who is a well-known racing canoeist, will tell how to paint and decorate canoes.

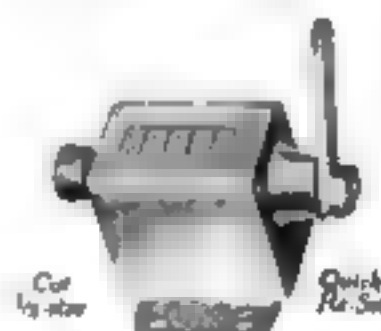
How Many Laps to Go?

Have you any machines a few laps behind in the race for speedier, cheaper production?

Let Veeder Counters measure their gait; indicate their proper stride; aid in developing faster work by keeping track of the gains.

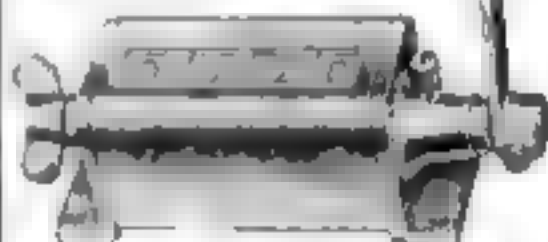
Set the pace, watch the count and run your machines for production-RECORDS on

Veeder COUNTERS



Above is small Set-Back Ratchet Counter, which indicates one for each throw of the lever, moving through an angle of 45 degrees. Reset to zero by one turn of knob: requires very little power to actuate it. Applicable to a wide range of light machinery. Price, \$6.00. Equipped with lock and key to prevent tampering with the record, \$2.00 extra. Also furnished in a Revolution Counter.

The Revolution Set-Back Counter below records the output of the larger machines where a shaft revolution indicates an operation.



Sets back to zero from any figure by turning knob once around. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels as illustrated, \$10.00 subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, \$11.50 (list).

The Veeder booklet shows instruments that "count everything on earth." See them—by sending for the book.

The Veeder Mfg. Co.
44 Sargeant St. Hartford, Conn.

The Shipshape Home

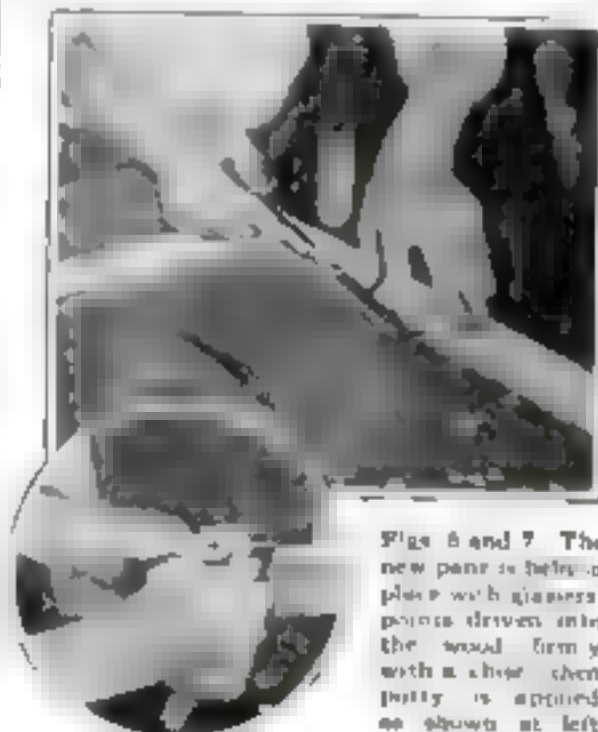
Continued from page 104



Fig. 5. See that the glass fits loosely. If necessary, remove small strips, as indicated.

To break the glass apart after the cut is made, the handle of the cutter may be laid directly under the cut at the edge of the glass and pressure applied as shown in Fig. 4. Another good method is to tap directly under the cut until the glass begins to crack and then break the piece apart with the hands.

Glass must fit loosely in the frame. If it is set tight it may break in time even if it does not do so at once, because of temperature changes and jars and shocks. So, if it crowds in the opening, it is better



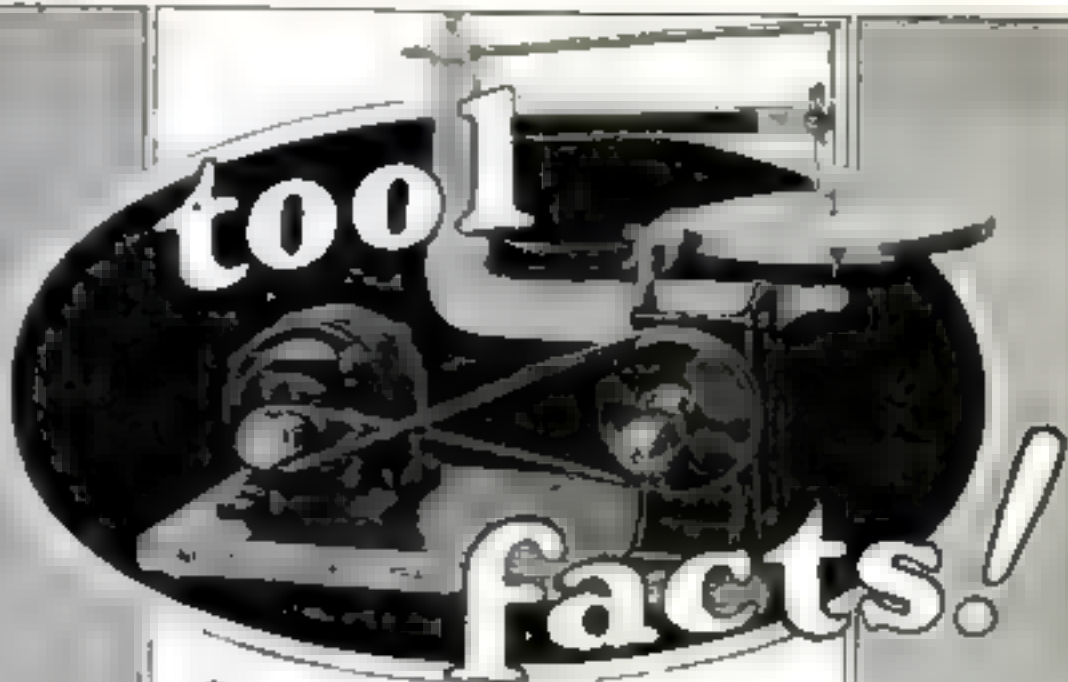
Figs. 6 and 7. The new point is being placed with glassers' points driven into the wood firmly with a chisel. Then putty is applied as shown at left.

to make a cut and remove a narrow strip as shown in Fig. 5. Do not make the mistake of trying to cut away the wood instead of the glass. It ruins the looks of the job.

Figure 6 shows how the glass is fastened with glassers' points. Do not lift the chisel from the glass; simply slide it back and forth. If you lift it once, you will probably have another piece of glass to buy. Points should be placed not more than 6 in. apart. Do not press down too much on the glass. The seat for the glass is at the best somewhat uneven after the glass has once been removed. It is better to leave some openings on the opposite side.

A neat job of puttying can be done after a trial or two if speed is not essential, although considerable practice is required before one becomes really expert. How to

Continued on page 108



6

You Can Afford this Motor Driven Scroll Saw

Aside from the joy in owning such a tool — one you've wanted a long time — from the standpoint of economy alone, you'll find it a good investment. You have two or three jobs now that this No. 1075 Scroll Saw will enable you to do yourself and not have to have done. A considerable portion of the cost of the saw will be offset by what you'd have to pay to have these jobs done — and you'll have the pleasure of following your bent and doing the work yourself. But better yet, you'll have the saw for the many, many jobs you'll want to do in future. A number of uses are suggested in this advertisement. Other uses are so numerous we could not begin to make a complete list. Being a Goodell Pratt Tool, it's a good tool and will last indefinitely for the Goodell Pratt name on any tool is a guarantee of quality and correctness in design.

Ask your local tool dealer to show you the New No. 1075 Motor Driven Scroll Saw in operation. If he hasn't one in stock, write us for detailed specifications and price.

Model Building
For cutting out and shaping up innumerable small parts.

Pattern Making
For delicate work on patterns of intricate design.

Antique Furniture — For matching odd pieces and parts in restoration work.

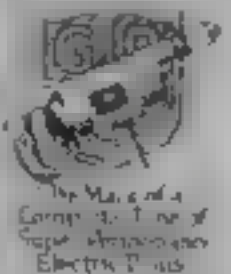
Sign Making — For cutting out block letters.

Jewelry — For roughing out shapes or ornaments of soft metal. A special attachment can be provided to take Jeweler's Saw Blades.

Inlaying — For the finest kind of inlay work in both wood and soft metals.

Wood Carving — For cutting out designs for applique wood work.

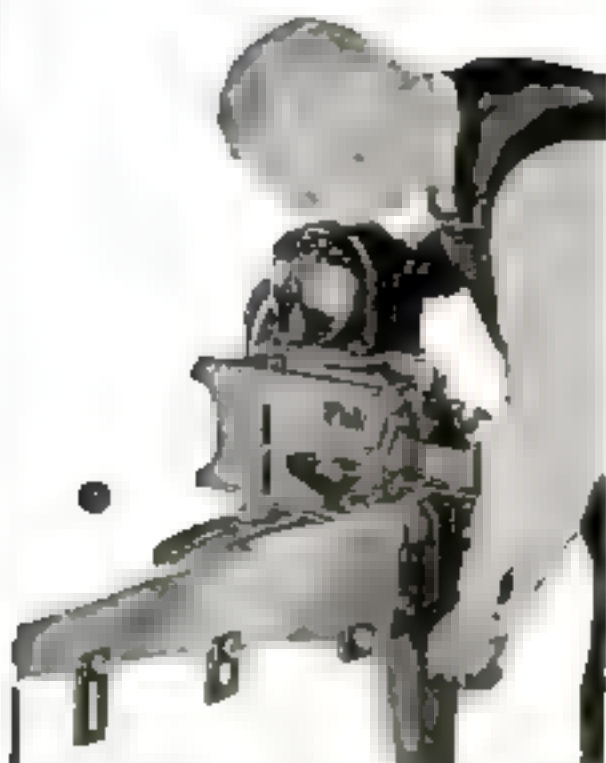
Cabinet Work — For a great variety of uses, such as cutting grills, ornaments, toys, etc., etc.



GOODSELL-PRATT COMPANY *Toolsmiths*, GREENFIELD, MASS., U.S.A.

GOODSELL-PRATT

1500 GOOD TOOLS



Do You Get \$2.00 to \$3.00 an Hour for Your Time?

You can make that much in an hour easily with a Foley Automatic Saw Filer. I filed six saws in 10 minutes at \$50 each. —Chas. E. Fisher, Larn, Ohio. H. P. Myers at Burlington, Iowa, says: "I get all the work I can handle. I receive \$2.50 for each saw I file."

A Business of Your Own

Build up a big year-around business of your own, if you get a Foley File saws for carpenters, contractors, schools, factories, meat markets, farmers and homes. You'll get their business, because your Foley will make their saws cut better than new. You can give them quicker service. The Foley files more than twice as fast as the best hand filer. No eyestrain. Just clamp the saw in it and snap the switch. No experience needed. No canvassing. Hardware stores and lumber yards will collect saws for you on a commission basis. Make big extra money while at your present work.

FOLEY Automatic SAW FILER

You can file hand, band and circular saws with this machine. It's the only one that will file them all. Retooth old hand saws and get \$1.25 and more a day.

We'll help you get started in a money-making saw filing business of your own. Mail this coupon for the valuable FREE Plan and a special demonstration offer in addition to a complete description of what you can do with a Foley. Mail this coupon now.

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1908 Foley Bldg., 9 Main St., N. E.
Minneapolis, Minnesota

Please send me the FREE Plan and demonstration offer which will get me started in a money-making saw filing business.

Name _____

Address _____

The Shipshape Home

(Continued from page 107.)

Apply putty is shown in Fig. 7. The putty which must be soft and pliable and of the best obtainable grade—is fed under the putty knife as indicated. An experienced person using putty of good consistency will run a continuous joint with one stroke. One stroke forward and one going back, followed by a light stroke with the finger to take off the little scraps left by the knife, complete the job.

It is well, however, particularly on old work, to put putty on the other side of the glass in order to fill any irregular open places left between the glass and the wood. Just a stroke with the putty knife will do this, and the sash is ready to be put back in place.

Wooden strips, called glass stops, are often used to fasten large pieces of glass and plate glass. When these are used it is seldom necessary to take the sash out of the frame for repair.

How to Fill Holes in Plaster Walls

By F. N. Vanderwalker

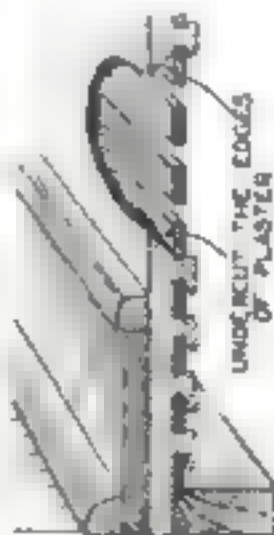
HOLDS in plaster walls from one to six inches in diameter as well as all wide cracks can easily be patched by any handy man.

Cut out all loose pieces right down to the lath and undercut the edges all around. When the patch is to be large, it is easier to make the material remain in place if galvanized nails are driven into the wood studs or laths. Sink the heads well below the surface of the wall.

The tools are a putty knife and a flat paddle whittled from soft pine. The wood paddle is best for putting on the finishing touches, because it smooths over the filling without leaving any ridges such as are left by a metal blade. A small pointed trowel is handy for inserting the material and for smoothing over it repeatedly.

The material best suited for the amateur's use in filling large holes is prepared patching plaster, but common plaster of Paris can also be used satisfactorily. It is best to do large fillings in two stages to allow for shrinkage. Add a little coarse sand to the plaster for the first filling only.

First wet the laths and the edges of the old plaster. Then fill the opening to a depth that will bring it up to within about 1/2 in. of the old plaster surface about it. Let that dry hard, overnight is usually time. (Continued on page 109.)



Cross section of a wall showing how the plaster is undercut to receive a durable patch.

Radio • Is BETTER • With Dry • Battery • Power



made to run the full race!

ANY horse can make a good start But it takes real stamina to finish!

So it is with batteries. *Staying* power is the quality to look for—unfailing power over a long period of service. Millions prefer Burgess Chrome Batteries for just this reason. They hold up They last.

Next time, buy black and white striped Burgess Chrome Batteries. You are certain to get longer and better service for your money.

Chrome—the preserving element used in leather, metals, paints and other materials subject to wear, is also used in Burgess Batteries. It gives them unusual *staying* power. Burgess Chrome Batteries are patented.

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BURGESS FLASHLIGHT & RADIO BATTERIES

The Shipshape Home

(Continued from page 108)

enough. Apply a second filling to finish the job, allow this to dry hard and then sandpaper lightly with fine paper. Coat with shellac and, when dry, with a coat of flat paint; then you are ready to paint, enamel or calcimine the wall, or to cover it with wall paper, fabric or plastic paint.

When plaster of Paris is used for such fillings, it is well to brush water over the filling after it has set a few minutes. When it comes to sandpapering, confine the strokes to the edges about the filling, because sanding the filling itself cuts through the glaze and makes a porous area. A porous filling absorbs the liquid out of paint or paste to the injury of the job. Shellacking the filling overcomes such porousness.

A GOOD second filling for holes when plaster of Paris and sand or prepared patching plaster is used for the first filling is one mixed from white lead-in-oil paste to which enough dry whiting is added to make it stiff. Add a little Japan drier or floor varnish and knead or pound the mixture with a club or wood mallet until smooth and well mixed. Then apply with a wide putty, stopping or glazing knife. Such a filling smooths up nicely, is nonporous and can be sandpapered freely without making it porous. It requires no shellac coat to seal it, but the margin of plaster around it, if cut through with the sandpaper, ought to be shellacked and touched up with flat paint.

Rough sand-finished plaster walls are treated in the same way except that in both the first and second filling of large cracks and holes, sand should be added to the putty. Beach sand is too fine and torpedo sand such as is used for mixing concrete is too coarse. Take some of the latter and sift it through a fly screen. What goes through will be just right. Have it dry before adding it to an oil putty, but for water putty dampness makes no difference. When finishing up the last filling of cracks and holes in this kind of surface, it is important to wipe any surplus putty from the old plaster. Use a dry brush for this purpose.

WHILE the filling is soft, stipple it. That is, pound it with any stiff, dry brush, such as a painter's duster brush or whisk broom. This is to make the filling rough enough to match the texture of the wall about it. A smooth patch would be very conspicuous.

If color is wanted in the putty, add dry colors such as raw sienna for yellow, burnt sienna for reds and pinks, raw umber for grayish brown and burnt sienna for walnut brown. Vandyke brown also is used and mixtures of these colors can be made to gain the exact shades. The color changes with the drying of the putty so that you must allow for that. Usually it gets lighter. Dry colors are used to tint both water and oil putties. Colors in oil will not do.

For patching areas one yard or more in size the prepared patching plaster may be used, or you (Continued on page 110)



those "Some-Day" Trips

Places you haven't visited — yet! Tours you've long planned. Fishing jaunts to lakes and streams where "big ones" have waited too long — for you!

Make those "some-day" trips this summer. You can afford them all with a Harley-Davidson. Fifty miles costs you only one dollar — just 2¢ per mile for gas, oil, tires, everything!

A Harley-Davidson Twin has power that laughs at hills — comfort that smooths out rough roads — safety features that make you complete master of every highway and trail.

Know the thrill of motorcycling. Let your local dealer demonstrate the Twin. Ask him, too, about his convenient Pay-As-You-Ride Plan.

Send the coupon for literature and full details.

HARLEY-DAVIDSON MOTOR CO.
Department P. S. Milwaukee, Wis.

HARLEY-DAVIDSON Motorcycles



The Single

The famous low cost, high-powered solo mount. 50 m.p.h., quick miles per gallon of gasoline — one cent per mile! Completely equipped, 1 a. b. factory, \$235.

Tear off and mail!

HARLEY-DAVIDSON MOTOR CO.
Dept. P. S. Milwaukee, Wis.

Send literature describing ☐ The Single ☐ The Twin
☐ The details of your dealer's proposition. Is my territory open?

Write your name and address in margin below

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THERE'S NONE EXACTLY LIKE IT

HERE is the finest covering material for masonry surfaces now on the market. Transform *your* basement workshop into a dry, bright room. You'll be pleased with the results and so will your family.

Send in the coupon below for free information and sample—or better still pin a dollar bill or a check to the coupon for a large working sample.

The SANDUSKY CEMENT Co.
1002 The Engineers' Bldg., Cleveland, Ohio
Manufacturers of Medusa Portland Cement Paint, Medusa White Portland Cement, paint and waterproofing. Medusa Co. Portland Cement, plain and waterproofed, and Medusa integral waterproofing.



Attached find dollar for large working sample

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THE SANDUSKY CEMENT COMPANY
1002 The Engineers' Bldg., Cleveland, Ohio

Name

Street

City

State

Hardware Dealer's Name

PS-28

The Shipshape Home

(Continued from page 100)

can go to any building material yard and get a sack of dry prepared plaster which needs only to be mixed with water. The hole to be plastered should be cleaned as described and thoroughly wetted. A square plasterer's trowel of steel is the best tool, but a similar one can be made of wood to serve the purpose. The plaster is forced into contact with the lath and pressed between the laths in order to form a key or wedge. The plaster is applied in two coats, the first one being finished off about $\frac{1}{8}$ in. below the level of the old plaster. When set, scratch the plaster in both directions with a stick to give anchorage to the finishing coat. Allow it to dry hard.

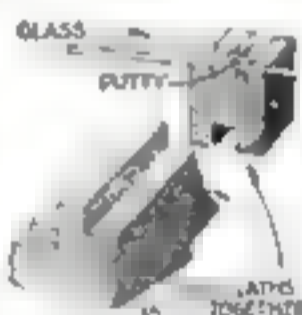
The finishing coat of plaster may be the same as the first coat or you may add some screened torpedo sand to it to give the desired texture.

This is the second of a series of articles on putties, fillers and cements. The third will appear in an early issue.

Hot Bed Sash

WANTING several hot beds without the expense of buying a stock sash for them, I made the necessary sash myself at little cost. The glass I cut from broken window panes, the pieces being $6\frac{1}{4}$ in. wide and from 1 to 3 ft. long.

I made the sash bars by nailing three common laths together side by side, keeping the upper edge of the center lath $\frac{1}{4}$ in. higher than the two outer ones. One end of these laths were cut like the ends of common rafters and nailed into a frame made of 1 in. thick lumber. The glass was then laid in the rabbets formed by the laths and puttied.—HARRY P. BOTSFORD.



Laths are used for making the sash bars

Cleaning Shades

Wall paper cleaners can be used for freshening up slightly soiled window shades. It is possible to clean linen shades of good quality by stretching them tightly on a curtain stretcher frame or tacking them on the floor and scrubbing them with warm soap-suds. They should be rinsed with warm water applied with a brush and mowed before they are entirely dry.—L.T.S.

Scrubbing Fireplaces

FIREPLACE bricks can be cleaned of soot and dirt, even if in very bad condition, by brushing them vigorously with a broom and applying a mixture of 1 pt. strong household ammonia and 2 lbs. of powdered pumice stone in a gallon of soft soap. Apply this with a brush and let it stand for an hour before scrubbing it into the surface. Rinse with water.

Pipe-loving Doctor Re-discovers His Favorite Tobacco

One whiff from another's pipe makes him stick to his good old standby

Just as the grass looks greener on the other side of the fence, smokers sometimes think the other man's tobacco smells sweeter than their own.

Recently a Charleston optometrist found himself enticed from the fold, only to discover that his old favorite had led him astray.

Charleston, W. Va.,
March 4, 1927

Larus & Bro. Co.,
Richmond, Va.
Gentlemen:

Recently I stopped in a little village that consisted of about nine houses and a small hotel, which I entered.

A little old man wearing a skull cap was seated in a rocking-chair smoking an enormous pipe. I had come to buy a can of Edgeworth but when I caught a whiff of the tobacco he was smoking I changed my mind. The aroma of that tobacco was so delightful that I made up my mind right then and there that I wanted some of the same brand, regardless of the cost.

I began with: "I beg your pardon, sir, but I came in to buy a can of tobacco, and I would like the same brand you are smoking if you don't mind telling me." He looked at me for a moment, grasped his pipe with one hand and said: "I'm smoking Edgeworth. Would you like some?"

Of course I did, and I secured a supply from the old fellow. The joke, of course, was on me, but I went on my way rejoicing.

Yours very truly,
Dr. John R. Kitch



To those who have never tried Edgeworth, we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to

Larus & Brother Company, 70 S. 21st Street, Richmond, Va.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Size and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidor holders a pound, and also in several handy in-between sizes.

[On your radio—tune in on WYFA, Richmond, Va.—the Edgeworth Station. Wave length 234.3 meters. Frequency 1180 kilocycles.]



Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

HYDROCHLORIC acid, or muriatic acid, as it is also called, is one of the primary chemicals used both in industry and the trades. Hydrochloric acid is a gas and is easily absorbed by water. The ordinary concentrated acid is yellow in color, when chemically pure it is water white. The yellow or technical acid is sufficiently pure for ordinary purposes at home or in the shop.

Brown stains on porcelain bathroom fixtures or sinks may be removed by letting the concentrated acid trickle (by means of a medicine dropper if the stain is small) on the stain until it is removed. Then wash thoroughly with water to remove all trace of acid.

Bricklayers use the acid for cleaning mortar or cement from face brick and brick fireplaces. The acid is applied and another brick used to rub the excess mortar from the face of the brick.

The tinsmith uses it for cleaning metal surfaces to be soldered together. The acid is applied to the metal, a drop or two at a time, usually with a thin stick. Such an acid soldering flux—for the acid acts like a flux—is very easy to handle and is extremely rapid in action. A "cut" soldering flux that is still better is made by dissolving as much scrap zinc as will go into solution in a bottle containing a little hydrochloric acid. This flux does not attack the metals to be soldered to any such extent as the straight acid.

A dilute solution of hydrochloric acid, one part of acid in one or two parts of water, etches aluminum rapidly. For slow etching, dilute the acid with five parts of water. Heat the metal and cool it with molten wax. When this is cold, scratch on the design or lettering, cutting right through the wax film to the metal. Apply the solution and when the metal has been etched deeply enough, wash thoroughly with water and remove the wax with boiling water.

The following label is intended to be placed on the hydrochloric acid bottle:

Hydrochloric Acid

(Muriatic Acid)

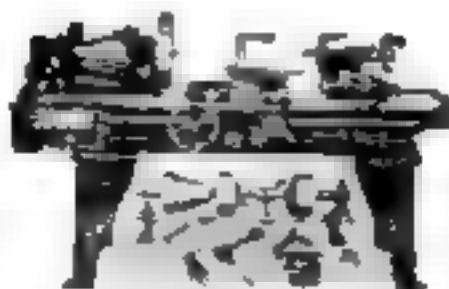
HCl

Hydrochloric acid is a very strong that it must be handled with care. The bottle should be kept upright and corked. A glass stopper is much to be preferred.

Keep the acid away from the skin. If the acid comes in contact with the skin, wash copiously with water at once. If this is not done it will produce burns and ulcers. If your clothes come in contact with the acid, wash the spots immediately with ammonia.

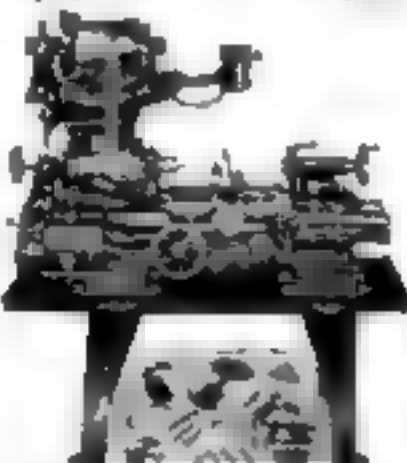
To clean stains from porcelain bathroom fixtures and sinks, drip the acid on the stain until clean and wash thoroughly with water. Drains are washed with the acid to clean them from mortar or cement. The acid may be used as a flux for soldering. A better flux is the acid "killed" with scrap zinc—much zinc as will go into solution.

Diluted with water, the acid etches aluminum. The metal is first covered with wax, and the design scratched through the wax.



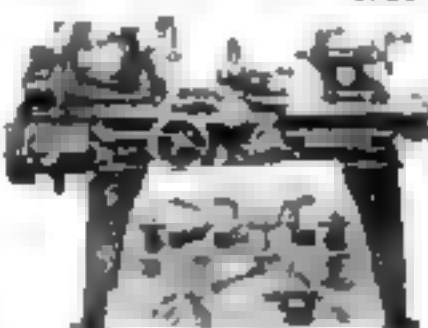
24 inch—Weight 2000 lbs.

Quick Change Back Geared Screw Cutting Lathe, 8 foot Bed. With countershaft and equipment - - - \$570



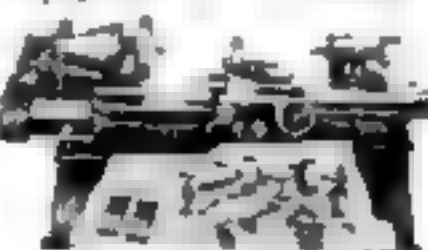
18 inch—Weight 1000 lbs.

Tool Room Quick Change Back Geared Screw Cutting Lathe, 4 ft. Bed. With motor and electrical equipment. Price - - - \$525



11 inch—Weight 675 lbs.

Quick Change Back Geared Screw Cutting Lathe, 3 foot Bed. With countershaft and equipment - - - \$325



16 inch—Weight 1175 lbs.

Gap Bed, Quick Change, Back Geared Screw Cutting Lathe, 8 ft. Bed. With countershaft and equipment, \$650

New Model South Bend LATHES

for the

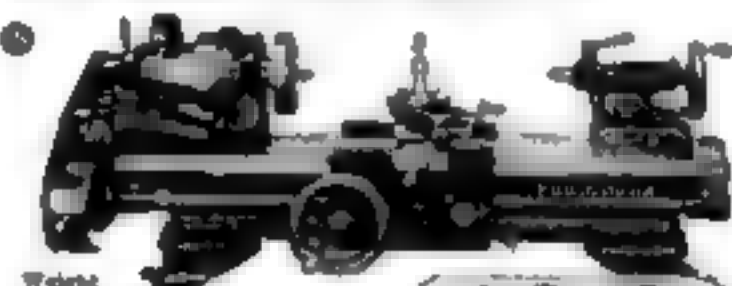
**Manufacturing Plant
Machine Shop—Service Station
and Electrical Shop**

Write for Catalog No. 88 showing complete line of New Model South Bend Lathes ranging from 9 inch to 24 inch swing and from 2½ to 16 foot beds—with countershaft or choice of 3 types of electric drives, all at surprisingly low prices.

Precision 84 accuracy tests with precision instruments applied to the manufacture of each South Bend Lathe insure its accuracy.

Speed Simplest adjustment and absence of all unnecessary parts enable operator to work at highest efficiency.

Durability South Bend Lathes are sturdily built of most durable materials.



Weight 275 lbs.

9' x 2½'

Back Geared Quick Change Screw Cutting

Complete with Countershaft and Equipment

\$150

Built in the same plant where 38,000 other fine Precision Lathes have been manufactured for the United States Government, Ford, Westinghouse, Bethlehem Steel Co., U. S. Steel Corporation and hundreds of other large industries in the United States and 64 Foreign Countries. It is the world's largest Lathe value.



Features

- Power Feed to Carriage
- Set-over for Taper Turning
- Hole through spindle ¼ in.
- Precision Lead Screw
- Cut threads 4 to 48 per in.
- Maximum draw-in Collar size ½ in.

Easy Payments If Desired

A small down payment brings you the Lathe to use while you are trying it. In this way it costs its own cost by the work it does and the savings it makes.

FREE—Write for No. 88 Catalog and New Booklets

Check off in the squares below, indicating the Lathes to which you are interested. Cut out and mail to us. Special booklet and catalog No. 88 mailed free postpaid on request.

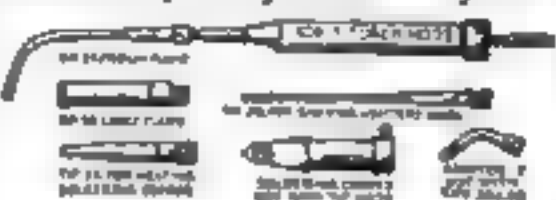
- | | |
|---|---|
| <input type="checkbox"/> 9 in. Junior Booklet | <input type="checkbox"/> 14 in. Lathe Booklet |
| <input type="checkbox"/> 11 in. Lathe Booklet | <input type="checkbox"/> 18 in. Lathe Booklet |
| <input type="checkbox"/> 12 in. Lathe Booklet | <input type="checkbox"/> General Catalog No. 88 |
| <input type="checkbox"/> 15 in. Lathe Booklet | <input type="checkbox"/> "How to Run a Lathe" |
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Jobbing Shop Short Cuts

(Continued from page 110)

were completed in thirty-five hours, which included the first piece machined on the 20-in. lathe. The average time per piece was forty-two minutes.

The next job John had was to make the twelve bushings as shown in Fig. 2.

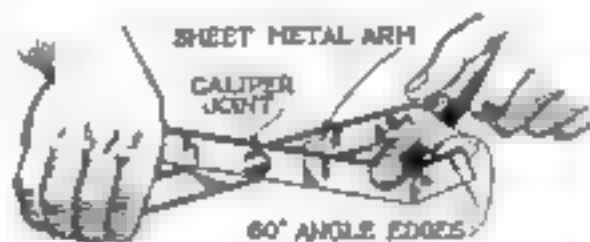
"You must allow finish for grinding, both inside and out, at least fifteen thousandths on each dimension," the foreman explained. "The pieces are already cut off in short lengths. Do the job in any way you like, only let me know how you plan to work it out."

John selected a horizontal turret lathe for this job, setting it up as shown in Fig. 4. In talking it over with the foreman he said:

"I figure we can keep a machine like this partly set up all the time for short jobs. I can hold the work (1) in chuck jaws and drill part way through while turning part of the outside with the carriage tools. Then I will remove the work and hold it by the finished end and complete the drilling from the opposite end, turning the remainder of the outside at the same time. The next step will be to bore and ream the hole all the way through. With this kind of set-up, other jobs of a similar kind can be easily handled by using various sizes of drills, boring bars and reamers when only a few pieces are required. It is quicker than an engine lathe, and stops can be set for duplicate work with less chance of error. After this operation, I would place the work on an arbor and finish-turn the outside, face the ends square and cut the groove."

The foreman nodded his head in approval and remarked, "If you can apply production methods on some of our short jobs, it is going to help us get more business while things are quiet, as they are now. A jobbing shop must always plan ways to get out good work cheaper than the other fellow, at the same time making a profit. If you can help us this way, you will find a substantial increase in the contents of your pay envelope before long." And he gave John a friendly slap on the back and a wink and strolled on through the shop.

Thread Cleaning Tool



The threads to be scraped are gripped near the back, or inner end and screwed outwards.

WELL fitting screws will bind unless the threads are perfectly clean. When a screw thread is blocked up with small particles or hard grease, I use a scraper of my own manufacture. It consists of two arms cut from No. 10 gage sheet metal and riveted together with a caliper joint, as shown. The blades which enclose the thread are filed to a 60-degree angle and left rough so as to form many minute scraping edges.—H. MOORE.



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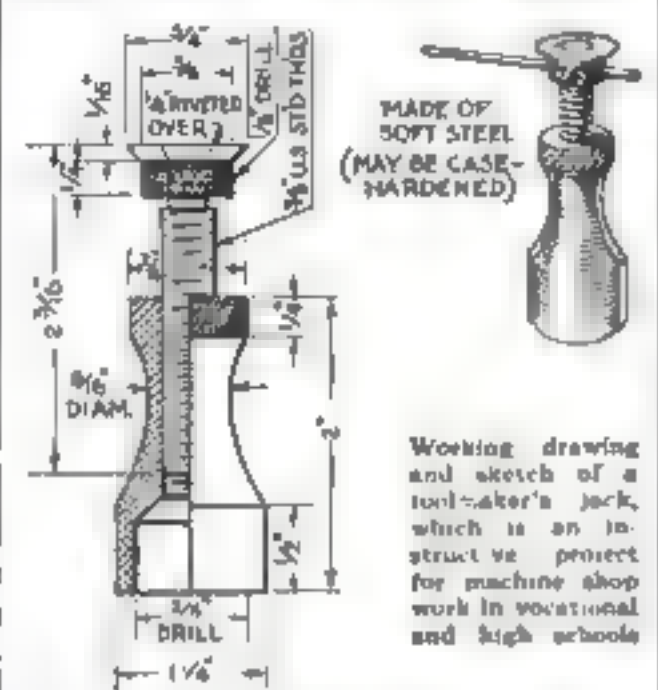


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Steps to Take in Making a Toolmaker's Jack

MAKING a toolmaker's jack is a useful and instructive project for the school shop. It involves the use of a number of tools and requires considerable care in machining; it also offers an opportunity for workmanlike finishing. The jack is made of soft steel. The tools required are hack saw, hammer,



center punch, 6 in. steel rule, scriber, tool holder, knurling tool, $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ -in. twist drills, $\frac{1}{4}$ -in. U. S. standard tap and die.

The operations are as follows.

For body—1. Chuck in engine lathe a piece of $1\frac{1}{2}$ -in. stock. 2. Face end off true. 3. Center end. 4. Turn $\frac{1}{2}$ -in. diameter. 5. Turn $\frac{1}{4}$ -in. diameter. 6. Knurl $\frac{1}{2}$ -in. diameter. 7. Make tin or cardboard template to fit design of body. 8. Turn body to fit template. 9. Drill $\frac{1}{4}$ -in. hole, $2\frac{1}{4}$ in. deep (on lathe rest). 10. Tap hole with $\frac{1}{4}$ -in. U. S. standard tap (on lathe). 11. Cut off work to lathe. 12. Drill $\frac{1}{4}$ -in. hole, $\frac{1}{2}$ in. deep.

For screw—1. Cut off a piece of stock $2\frac{1}{2}$ in. long. 2. Center end. 3. Turn $\frac{1}{4}$ -in. diameter. 4. Knurl. 5. Turn $\frac{1}{4}$ -in. diameter. 6. Taper out to $\frac{1}{8}$ -in. diameter at head. 7. Turn $\frac{1}{4}$ -in. diameter, $\frac{1}{2}$ in. long. 8. Cut thread on screw, using $\frac{1}{4}$ -in. U. S. standard die for finishing. 9. Drill $\frac{1}{8}$ -in. holes in head.

For top—1. Chuck in engine lathe a piece of $\frac{3}{4}$ -in. stock. 2. Face end off true. 3. Center. 4. Drill $\frac{1}{4}$ -in. hole. 5. Countersink. 6. Turn 45-degree beveled edge. 7. Cut off work $\frac{1}{2}$ in. wide (on lathe). 8. Rivet top and screw together. 9. Assemble to body.

It should be noted that the screw may be case-hardened and the top may be filed rough, similar to a knurl.

This is the third of a series of projects that young machinists can make. The fourth will appear in an early issue.—H. B. KELLAM.

Cork Pads for Clamps

EXCELLENT pads to keep small clamps from slipping or marring the surface of polished metal can be obtained by gouging out the thin cork pieces in the caps of soda water bottles.—F. B.

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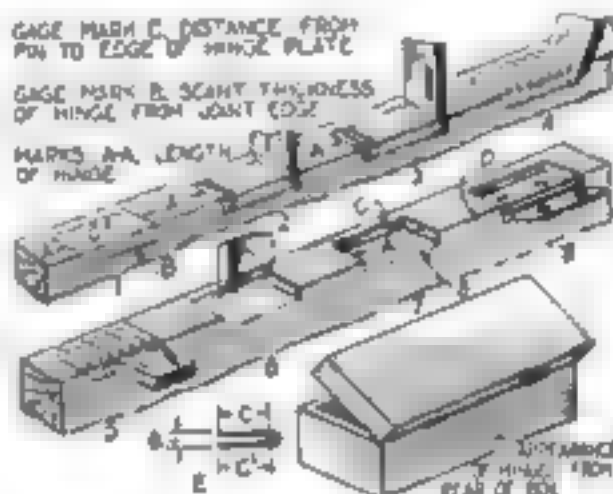
The David Maydole Hammer Co. Norwich, CT

How to Fit Hinges Like an Expert

FEW problems give a more accurate measurement of a home worker's skill than the fitting of a pair of hinges. In doing this the only mark or cut that is "good enough" is that which is as near absolute accuracy as the worker can make it.

The exact length of the hinge *AA* should be marked from the hinge itself with a knife point. Never use pencil lines where accuracy is required. Line *B* should be made with a sharp gage set about the thickness of a piece of paper less than the parallel thickness of the hinge from the joint as shown at *E*, which will prevent the joint from becoming hinge bound. The gage line *C* should equal the distance between the edge of the hinge plate and the pin, as shown at *E*; if very fine work is desired, the distance should be as at *C'*, but *C* is commonly used.

In cutting to the lines, use a thin edged chisel about $\frac{1}{8}$ in. wider than the dis-



The steps to follow in marking and chiseling hinge mortises on box lids and cabinet doors

tance *C*. Make the first cuts as shown at 2, which will allow cuts *A* to be made accurately as at 3. Cut the wood away by using the chisel as at 4 and work carefully to depth line *B*. Place the edge of the chisel in line *B*, as shown at 5. Cut the wood away back to the line *C*; hold the chisel as at 6 and cut gently, for there is danger of breaking out the wood back of *C*.

Trim the cuts carefully, making the lower surface or bed of the hinge *ABC* and the back cut straight and smooth as at 7. Fasten the hinges with screws as at 8. Be sure the pin is in accurate alignment with the corner *D*.

Lay out the distance *C* where each hinge is to be placed on the other member of the joint, and locate the exact endwise relationship. Set the hinges at these marks and drill a hole in the wood at the center of one hole in each hinge. Drive the screws until each hinge is pulled down to its place. Inspect the surface relations of the members of the joint. Small inaccuracies may be remedied by loosening the first screw of one or both hinges as may be necessary and drilling a hole for the other screw of each hinge close to that side of the hole, which will tend to force the hinge endways or sideways as may be needed.—C. A. K.



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"Old Town Canoes"

Restoring Old Furniture

(Continued from page 95)

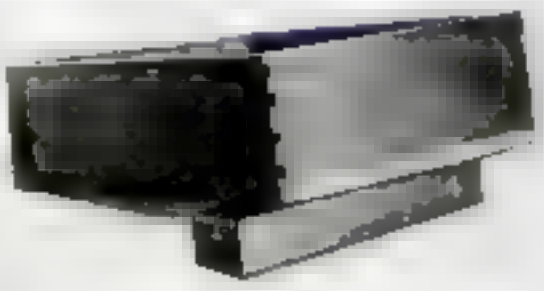


Fig. 3. How a badly worn drawer may be built up by gluing a strip to the bottom.

size and every detail of design should be preserved, regardless of the desire to change it. In repairing a piece with drawers, where the drawer slides have worn beyond their usefulness, they may often be used by turning them end for end and putting the bottom side up, or shifting them from one end of the drawer to the other.

The end of the drawer being worn down so that the bottom of the drawer chafes on the parting rail, the drawer end should be built up by gluing a strip to it, and then refitted to the opening. Figure 3 shows a drawer repaired in this manner.

Figure 4 is a clamp made from rough 1 by 3 in. oak (crating lumber). It may be made for a few cents, but is worth many dollars. It can be of any size to suit the particular needs of the maker, so no dimensions are given. This was used to clamp up the drawer end in Fig. 3, but several other ends were clamped at the same time.

Figure 2 shows the same clamp with the work glued up in it. Note that irregular work may be glued up, and that pressure is exerted by driving pairs of wooden wedges between one side rail and the work. For narrow work, part of the clamp is filled in with pieces of board. The wedge away from the work is set in place and nailed to a crosspiece to avoid slipping, and the work is clamped to the crosspiece to avoid buckling.

In Fig. 1 is shown the same type of work clamped up without the use of metal clamps. A clamp of this kind may seem slow and

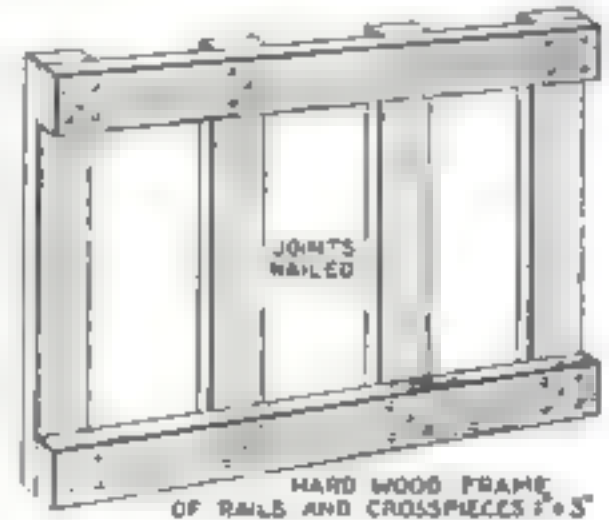


Fig. 4. A clamp such as those illustrated on page 97. It is made of crating lumber.

unwieldy to one who has never used it, but it is not. The writer has several different sizes; they save time and money, especially in the home workshop.

Old dovetailed joints will become loose and "rickety." These should not be nailed until every joint has been disassembled, cleaned of accumulated dust and dirt, and glued (one of the best glues for all-round repair work was described on page 87 of POPULAR SCIENCE MONTHLY for January, 1927). If the old joints are loose enough to require nailing as well as gluing, use cut. (Continued on page 118)

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Fig. 7, S. P. 08.

In the building of the clipper-ship model shown above, Mr. Nichols says: "Plastic Wood aided me in many ways. It was used in filling up the cracks between the seven layers of $\frac{1}{8}$ -inch board used for the hull; it was used in the tops, caps, and crosspieces to make them secure to the masts, and in making the bulwarks fit tightly to the hull. Plastic Wood was also used to fill openings around the masts and bowsprit and for such minor uses as securing heavy pins, pumps and deck fittings to the deck. Also for modeling the figure head and decorations."

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Restoring Old Furniture

(Continued from page 117)

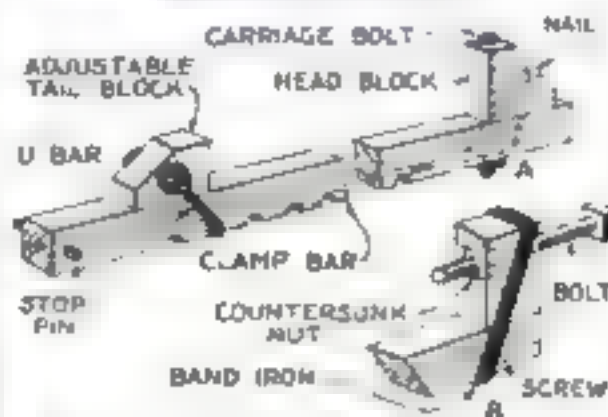


Fig. 5. How to make inexpensive wooden substitutes for regular cabinetmaker's clamps

nails of a length not more than three times the thickness of the board being nailed. Cut nails hold better and longer and also drive straighter than bristing nails.

It appears that nearly all glue used 100 years ago or more was of the resin variety, very little lime glue being used. The best glue joints made with resin glue will part after a number of years. When resin glue is discovered in old joints, every joint in the piece should be parted and reglued with good hide glue, after all the old glue has been cleaned off.

Where nails are found to have been driven in the face of the work, they should be removed without marring the piece, if possible. Some may be backed out with a nail set, others removed with a claw hammer or pliers. If this cannot be done, they should be set deep enough to allow a small patch to be placed over them. Patching will be discussed in detail in a later article.

All woodworking mechanics know that nails should not be driven in the face of good cabinetwork, if it can be avoided. Whenever possible, face material should be fastened from the back with screws, but where it becomes necessary to do face nailing, secret nailing should be employed. One method of secret face nailing is as follows:

Drive a chisel of medium width and with an extra long bevel and razor edge into the wood about $\frac{1}{2}$ in. deep at an angle of about 45 degrees to the face of the work. Lift a wedge-shaped piece of the wood high enough to allow a nail to be driven under it. Be careful not to tear the piece out. Remove the chisel and drive the nail in the incision, put a little glue in the cut and press the piece back in place.

IF THE chisel has been properly ground and the work carefully done, no clamping will be necessary. With ordinary care this kind of nailing may be done in the face of fine work and be invisible in the finished job, but it requires a certain amount of skill, so it is good policy to keep in practice on scrap material.

Another inexpensive but valuable clamp that the busy worker can make for himself is shown in Fig. 5. Every shop needs at least three clamps of this kind. They may be made in many sizes, but a good heavy-duty bar is of $1\frac{1}{2}$ by 2 in. stock. Yellow pine, maple and oak are excellent materials to use.

The head block construction shown at A is for the use of wedges, but the second method of head block construction, indicated at B, is for a bolt, which passes through a countersunk nut. If the second method is used, the hole for the bolt should be the same size as the bolt, so as to keep the bolt in a straight line with the clamp bar.

Clamps of this kind may be made with 4 by 4 in. bars and set on legs the same as saw horses. These are for the heaviest of work.

This is the second of a series of articles that reveal the secrets of an expert restorer of antique furniture. The next will appear in an early issue.

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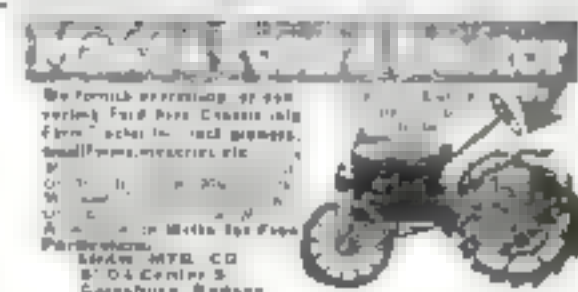
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SEA ARTS GUILD
736-N WINNEBAGO ST., MILWAUKEE, WIS.



The Mayflower

(Continued from page 81)

$\frac{1}{2}$ in. thick. They may be glued and nailed on the surface of the hull, but are better abetted into it, that is, set in grooves. They should really be scarfed together as shown by dotted lines on Blueprint No. 85, but it is easier to extend the keel the whole way and to nail through it. Note that our keel extends above its rightful position at the stern to meet lift A.

The chief difficulty here is at the stem because of the long, extending cutwater. If the cutwater is laid out so that the grain of the wood runs diagonally along it, the whole can be in one piece. Some may prefer to make it and the knee in one piece and the stem proper in another, or three-ply wood might be used, in which case the grain could be ignored. The cutwater will be well supported when the beam-rails are on. The lead for the tacks under it may be part of it or glued on. The hole for the gunwoning should be cut before fixing. (See Blueprint No. 84 for these details.) Do not let the knee extend any farther than shown.

Our bulwarks and the sides of the fore and stern castles will be in one piece. The best material for this is three-ply wood from $\frac{1}{2}$ to $\frac{3}{4}$ in. thick, each 4 by 17 $\frac{1}{2}$ in. If this is not available, thin straight grained pine will do, this will need steaming at the forward end. If you can obtain $\frac{1}{2}$ in. thick airplane stock (three-ply wood) you will find it invaluable for this and many other purposes.

Whatever the thickness, cut a rabbet (groove) no deeper than necessary. The rabbet should extend from the top of the lift down to the dotted line shown. Cut your bulwarks as shown on page 80, leaving plenty at the ends to allow for the curve and fitting. It is best to try out all parts in cardboard before cutting the wood.

Cut out the two gun ports and three windows and glue cellophane film back of the windows.

Attach lift J at its forward edge and between lines 6 and 7 and lines 8 and 8 $\frac{1}{2}$ erect bulkheads cut from your $\frac{1}{2}$ -in. wood, with their edges shaped to conform to the body plan, less the thickness of the rabbet, and their heights as shown. Their upper edges must have the required camber. Attach the after one and a batten or block with the same camber. Right aft cut a piece to the shape of the transom with its top and bottom edges beveled so that it stands at the right angle. Cut its after edge to the profile of the sheer plan. These are firmly glued and nailed in position.

NOW glue the bulwark pieces on and nail them very firmly, first along the lower edges, then work up so that they fit snugly to the hull and conform with the body plan lines. Nail them, so far as possible, where the wales will cover the bulkheads. Leave the after end extending until the stern boards are in position.

From this piece of pine fit the pump deck and half deck aft, with their forward edges extending $\frac{1}{2}$ in., or more, beyond the bulkheads, and rounded.

The deck plank markings may be scribed with a very hard pencil. They should be truly fore and aft at about $\frac{1}{4}$ -in. intervals.

The longitudinal strengthening pieces, called wales, go on next. They may be strips of straight pine, but charmaker's rattan splint is the easiest material to use. The three lower wales should be $\frac{1}{2}$ by $\frac{1}{2}$ in. and the two upper ones about one third less each way. They are glued and nailed at the positions shown, their forward ends being beveled to butt against the stem and the after ends, square. The upper one aft should be steamed and sharply bent to mortise into the waist rail. Another wale goes across the stern just above the level of the second side wale. There is a plan of the wales on Blueprint No. 85.

The lower deck gun (Continued on page 120)



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CLEMON BROTHERS, INC.
MIDDLETOWN, NEW YORK

**STAR
HACK SAW BLADES**

The Mayflower

(Continued from page 117)

ports may be indicated with V-cuts or fitted with open shutters, as will be later described for the upper deck ports, or as I made my stern ports, which is with a wedge-shaped piece glued on, as if the shutter were just a little open; this clearly defines them, but saves the work of fitting them with guns inside. Their positions are shown on Blueprint No. 85.

To cover the end grain across the bulkheads and stern, thin wood overlays should be fitted. A fine grained hardwood looks best. They should fit very snugly all round. On either side of the forward one there should be a heavily lugged door. The second may have double doors in the middle. The first aft, a more ornate door, with arched center on each side but clear of the ladders. The after one should have a door in the center. The doors should have neatly carved panels and trim.

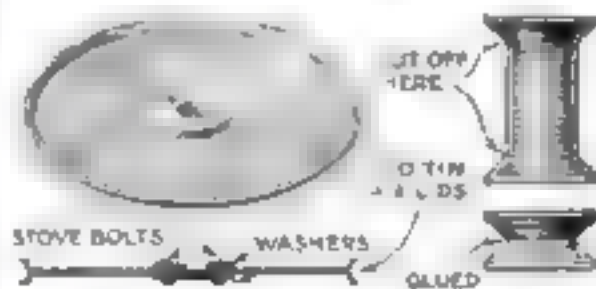
THE upper board across the stern extends $1\frac{1}{4}$ in. above the bulwarks at the sides and curves up nearly $\frac{3}{2}$ in. to the middle. It fits between the bulwarks, which are then trimmed to it. There must be, of course, a second board to fit on the flat surface below the upper board.

No one knows what design there was on these two boards, which form the finished stern. You may put what you wish, provided it is reasonable. The Pilgrim Society model has painted on the upper part a margined, to represent a mayflower, surrounded with a triangular border, and below, the name and dolphins. It is the one part of the model I do not like, so above I carved a Tudor rose (heraldic) surrounded with a rope design, and below I carved dolphins that infold the windows. These details are shown on Blueprint No. 84. The dolphins I first sawed out of a very thin piece of wood and glued on to another in which the windows were cut, trimming the edges and adding some surface carving. This is just an easy method of obtaining the effect of deep carving, which is perhaps more workmanlike.

Across the lower edge of the upper board I painted the name in red on the wood, which I had previously stained black. I stained the rose red and white, the rope and dolphins dark green and the ground dark brown, and lightly varnished the wood to bring the colors up.

Next month we will finish the inside of the bulwarks, make deck fittings, and do some coloring.

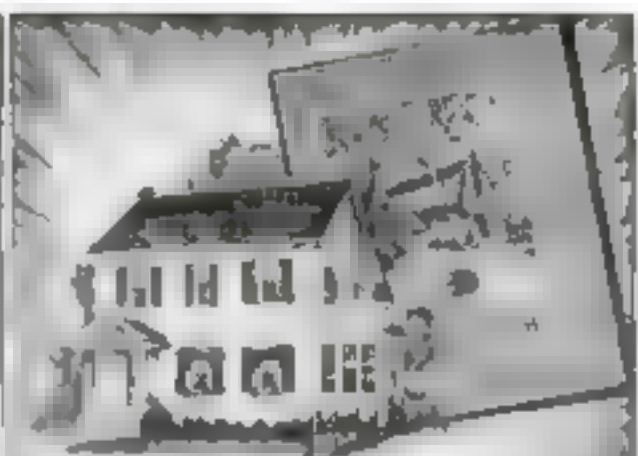
How to Make Small Pulleys



A pulley for light work made from syrup can lids, another formed from the flanges of a spool

IN THE workshop a pulley for light work or for a temporary model is sometimes needed. It can be made from tin lids taken from syrup cans, or smaller lids of the same style. Two lids placed together form one grooved pulley. A washer is placed on each side and holes are drilled through so that the parts can be fastened with stove bolts. On pulleys more than 3 or 4 in. in diameter, a steel disk or extra large washer will keep the lids from buckling. How to key, screw or wedge the pulley on the shaft depends upon the character of each job.

A small pulley for models or toys is obtained by sawing out the center from a good sized spool, as illustrated, and gluing the ends together. —ERIC B. ROBERTS.



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Power Unit Built at Low Cost

(Continued from page 96)

necessary to have a console cabinet. The type of cabinet has absolutely nothing to do with the correct operation of the electric receiver. If you prefer to mount the electric set in a standard type cabinet and place it on an ordinary table, you can put the amplifier and power unit on a lower shelf.

The amount of heat developed by this amplifier and current supply unit is not nearly so much as that produced by the high power unit described last month. However, some ventilation must be provided for, and while it is not necessary to cut out the back of the lower compartment, you should bore a row of holes in the back near the floor of the compartment and another near the top of it so that there will be a circulation of air. Use a $\frac{3}{4}$ - or 1-in. auger bit for these holes.

CONNECTING the electric set to the amplifier and power unit is a simple matter. The $1\frac{1}{2}$ - and $9\frac{1}{2}$ -volt leads from the set are clamped under the proper binding posts on the filament transformer B. The in-line B, 45-volt and 90-volt leads are brought down to the binding post thus marked on the power unit, and the P lead is brought to the P binding post—keep this wire away from all the others.

The loudspeaker cord tips are connected to the binding posts marked "loudspeaker."

Now insert 1 X 285 tubes in sockets G1, G2, G3 and G4 of the electric set and place a UX 247 tube in socket G4. Put a type-BH rectifier tube in socket H1 of the power unit and put UX 171 power tubes in sockets H2 and H3. Make sure that the switch on the end of the cord from transformer B is in the off position and insert the plug on the end of the other cord from transformer B in the nearest electric light socket.

TAKE a last look around to make sure that you have made no mistakes and then throw the switch. You should at once hear a high pitched squeen from the loudspeaker. This will continue for from thirty to forty-five seconds and then it will die away to complete silence unless a station happens to be tuned in, in which case the music will be heard. If it does not work this way turn the switch to the off position and do not turn it on until you have located what is wrong.

Never touch any part of the power amplifier and current supply unit while the current is turned on. Never attempt to operate the outfit unless the specified tubes are in all sockets.

Note that the type-BH rectifier tube gives no visible indication that it is in operation. When it is working at full capacity it looks just as it does when it is standing idle. Appearances are deceiving, however; the tube normally gets very hot while in use, so do not risk a burned hand by attempting to remove it from the socket right after you turn off the switch. Give it a minute or two to cool off. Of course, there is no occasion to remove this or any other tube in the complete outfit after once it is installed until it gives out after a year or two of use.

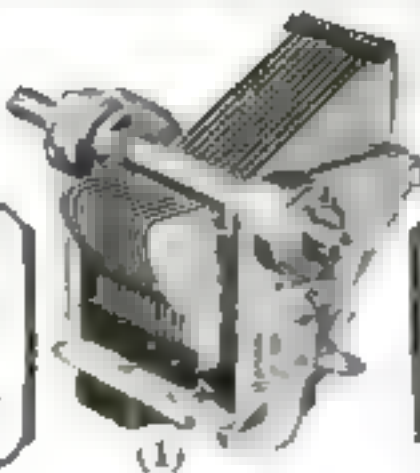
All operating voltages are fixed. The 171 power tubes operate with 180 volts on their plates and with a 40-volt C-bias, and they draw from 32 to 40 milliamperes. The tubes in the electric set operate at practically the same voltages as were specified last month when the high power unit is used except the first audio amplifier tube. With this power unit the first audio tube has 150 volts applied to its plate, the C-bias is ten volts and the plate current is $4\frac{1}{2}$ milliamperes.

The first operation is to set the potentiometers for the

(Continued on page 125)

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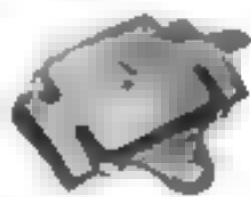
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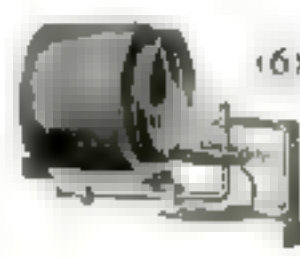
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3. **AmerChoke, Type 854,** is similar to AmerChoke, Type 709, except that its rating is such that it has an inductance of 50 Henries at 50 m.a., and is designed for the second step in filter circuits such as the Popular Science Electric Set, where such a reactance is required. Price, \$6.00.

AmerTran Tapped Resistance, R 400. This resistance used to reduce the high voltage supplied to the plates of the power tubes, to voltage suitable for the plates of the other tubes, is especially designed for this purpose. Price, \$7.50

Other AmerTran products used in this popular circuit are the AmerTran De Luxe first stage audio transformer, (\$10), AmerTran Input Transformer, Type 151, (\$15) and AmerTran Output Transformer, to work out of a pair of UX 210 tubes into a 2000 ohm speaker, Type 152 (\$15), or the Type 271 Output, the primary of which is matched to a pair of UX 171 tubes, and its secondary to a 2000 ohm speaker.

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Power Unit Built at Low Cost

(Continued from page 121)

minimum hum in a quiet room with the loudspeaker close to your ear. Set the potentiometers R2 and R3 in the power unit so that the contact arms are approximately at the center of the windings and slowly turn the contact arm of E5 in the electric set until the hum is as weak as possible. Then adjust potentiometers R2 and R3. You will find that the adjustment of these two potentiometers is not at all critical.

The next step is to adjust the balancing condensers C4 and C5 in the electric set to get rid of the squeal. This procedure was described last month. It is exactly the same no matter which power amplifier and current supply unit you use.

You must use a wooden screw driver made up from a piece of wood that has been slotted and a metal washer forced into the slot and filed to fit the adjusting screws of balancing condensers C4 and C5. This screw driver is necessary to eliminate hand capacity and the possibility of short circuits.

Turn the drums to about thirty degrees and get the squeal as loud as possible. Put the covers on shields N2 and N3. Slowly turn the adjusting screw of condenser C4 until you strike a point where there seems to be a radical change in the squeal—a broken or fluttering effect. Put the top on shield N1 and remove the one on N2. Turn the adjusting screw of C5 until the squeal disappears. If you can't find a point where this happens, change the setting of C4 slightly and try again.

When the adjustments are completed, the receiver will require no further attention until the tubes eventually give out and have to be replaced. And as the tubes are rated at 1000 hours of service, this means that you probably won't have to touch the set except to turn it on and off and tune it for at least a year.

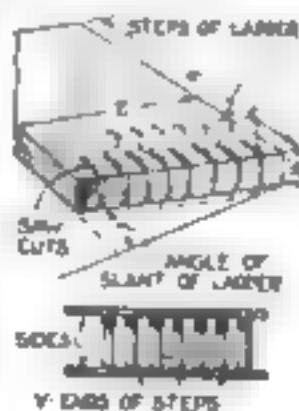
If you encounter any difficulties, either as to the details of the construction, wiring, and operation or in obtaining the proper parts, explain your troubles as clearly as possible in a letter addressed: Radio Editor, POPULAR SCIENCE MONTHLY, 230 Fourth Avenue, New York.


Simple Holder Aids in Gluing Ship Model Ladders

IN SHIP model work, finding that the little ladders were difficult to make, I devised a holder to aid in assembling the parts. It is made of maple $\frac{1}{2}$ by 2 by 4 in. One end is cut off at an angle of about 35 degrees, and with a fine hack saw slots are cut $\frac{1}{8}$ in. deep and about $\frac{1}{8}$ in. apart on this edge. The cuts are made, of course, parallel with the long edges of the piece.

Of very thin wood cut the number of steps desired. Make the two sides of the ladder considerably oversize. Then place the steps in the slots of the holder, coat one face of each of the sides with glue, set them against the projecting ends of the steps, and fasten the whole with a C-clamp.

I discovered that it is even more satisfactory to cut the ends of the steps V-shape and make corresponding V's in the sidepieces before gluing the ladders together. This makes a stronger joint.—CLETON F. GLOTT.





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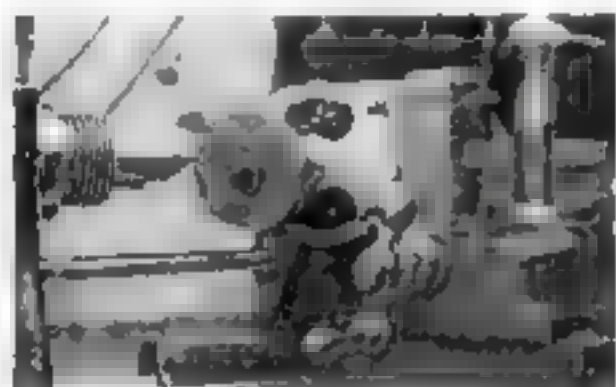
Victoreen Radio Co., 175 Varick Street, New York, N. Y.

Tool-Post Grinder for Your Lathe

By J. Carroll Tobias

EVERY mechanic who owns an engine lathe and attempts anything but the most elementary work appreciates the need for a tool-post grinder. Such a grinder is often a necessity when making odd-sized reamers, forming tools, making cutters and other special tools, as well as mandrels, drill-chuck arbors and the like.

The grinder illustrated was made at small cost for a lathe used in an experimental laboratory. A small 110-volt universal motor, formerly used to drive a working model, was utilized. In place of the four feet usually supplied for vertical bolts, it has two projecting lugs for hori-



Tool post grinder with fine grit wheel set up for finishing a hardened lathe center

zontal screws. This complicated the mounting to some extent.

For the shank a piece of $\frac{3}{8}$ in. square cold drawn steel was chucked in an independent jaw chuck and turned down at one end to $\frac{3}{8}$ in. and threaded $\frac{3}{8}$ in.-10. This was held in the tool post and the motor spindle ends were supported on the lathe centers; then, with the mounting plate in place on the motor, the carriage was raked back and forth to mark the correct height for the hole in the plate. The hole was drilled and tapped to fit the shank, which was screwed in tightly and "sweated" fast to insure rigidity.

The motor shaft is $\frac{3}{8}$ in. in diameter, so a piece of $\frac{3}{8}$ -in. steel was chucked, drilled and reamed to $\frac{3}{8}$ in. plus .001 in. and a shoulder $\frac{3}{8}$ in. in diameter turned on the end beyond the spindle recess for a distance long enough to accommodate the thickness of the wheel plus a flange and nut. The shoulder was then threaded $\frac{3}{8}$ in.-16 and the body drilled and tapped for two No. 8-32 set screws for fastening it to the motor spindle.

With a 3 in. diameter wheel at a motor speed of 2,500 R.P.M., the surface speed of the wheel is 1,963 feet a minute. At this speed a fine-grit wheel will produce a beautiful polish on hardened steel, and work can be performed with extreme accuracy.

WHEN mixing small quantities of chemicals or paints in the home workshop, you can improvise a measuring glass from a glass jar or tumbler and a rubber band. When you have decided what your unit of measurement is to be, put the rubber band around the glass so that it will be a mark for duplicating the measurement



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Lindbergh—How He Does It

(Continued from page 14)

those are part of the program of promoting public interest in flying. But once the curtain drops, Col. Charles A. Lindbergh, public character, disappears and Slim takes his place.

"Let's beat it out of here," said Col. Lindbergh one night at a theater party recently in New York. "I'm tired to death, I want to go to bed." On the way to his hotel someone started to talk about aviation. It was half past four in the morning when Slim turned in. "He'd have been talking yet if we hadn't gone away and left him," one of his friends told me. And how the man can ask questions when he comes across anybody who appears to know more than he does about any phase of aviation!

"The only time I ever saw Lindbergh when he seemed completely happy was when he was getting into his plane to start off on a flight—any flight," Casey Jones, veteran pilot and head of the Curtiss Aviation Service, told me. "He doesn't feel at home or seem at ease anywhere except in the air."

THAT'S just it. He isn't at home anywhere except in the air; but in the air is where he lives.

Few people know that Lindbergh planned his Paris flight for more than a year. J. T. Hartson, of the Wright Company told me. "He went at his preparations quietly but thoroughly. The first thing he did was to come East and talk with all the experts he could find as to the best type of plane to use. He concluded a monoplane was the thing, because of its lift and speed, and asked us to sell him the Bellanca which Chamberlin later flew across in. We had thought of going into the plane business as well as making engines, and had engaged Bellanca to design a ship for us, which we built. We wouldn't sell it to Lindbergh though he offered a grand deal more for it than we afterwards got from Levine. We just didn't think anybody ought to try to cross the Atlantic in a single-motored plane. We didn't know Slim then. So he went out to the Coast and got the Ryan people to build him a plane. And if you don't believe that he knew just what he wanted, and stood over the job to make sure that he got it, you don't know Slim. There isn't anything about a plane or an engine that he doesn't know.

"We didn't want to sell him an engine, either. We thought he was taking too long a chance. If it. Franklin Mahoney, president of the Ryan Airline, hadn't had a contract with us under which we were bound to deliver a Whirlwind engine whenever he had a customer for it, Slim never would have got his. Mahoney called me up on the telephone from San Diego and talked me into shipping the engine, but believe me, we gave it an extra inspection and a few prayers before we shipped it.

PLANNING, studying navigation, learning everything he could about weather and reading weather maps, getting pictures of the terrain and the landing fields so that he would know where he was and how to land, he is a flyer who takes few chances. There's nothing of the daredevil about Slim. He has had every kind of experience an airman can have, except war, he has met and conquered every kind of emergency which can happen to a flyer. Nothing frightens him, because he knows what his plane can do, what his engine can do, and what he, Slim Lindbergh, can do.

"Before I ever saw Lindbergh's face I was sold on him," Eddie Mulligan, dean of the Wright service corps, told me. "I had been sent to look over his motor, and the minute I saw that shiny nose of his plane circling around for a landing, I knew there was a flyer inside of her. Don't ask me how I knew it, you can't tell it in words, but..." (Continued on page 145)



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A definite program for getting ahead financially will be found on page four of this issue.



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How Do They Know About Atoms?

(Continued from page 45)

Too, he can make an excellent estimate of the distances between them from his studies of the frequency with which a radioactive projectile like a radium ray collides with them, a collision that actually gives a visible flash of light. Immediately he can get out his pencil and paper and tell you the size of the atom itself.

It is the chemist, again, who weighs the atoms against each other. All he requires is the relative weights in which the atoms of the elements enter into combination with each other and that he can determine with the utmost accuracy.

There is the relative weight of the atoms established, and their size measured. But what does the inside of the individual atom look like?

Suppose we had a microscope that could look farther into the molecule and see the atom itself. Let it be such a great among microscopes that it will magnify atoms ten billion times.

WHAT do we see? A miniature solar system of planetary "electrons," miniature satellites, revolving about a central sun. We look again and see between the electrons and the central nucleus great dreary wastes of empty space, vaster even than the spaces between the stars in the heavens. Into the nucleus is crowded practically all of the atom's mass, yet on the scale we are imagining it is no larger than a pin point—the most paradoxical unit in all creation.

That is the modern conception of the atom we have never seen. For years we believed it was the smallest possible indivisible particle of matter. Now we know differently.

For that we have a whole line of experimenters to thank. Sir Ernest Rutherford led the latest attack on the atom's mysteries, after pioneers such as Mendeleef, Dalton, Meyer, Thomson, Berquerel and Madame Curie had started the experimental ball rolling. Rutherford proved the complicated radium atom, far from being "indivisible," blew up of its own accord to spew forth re-formed atoms of helium, an entirely different element. What was more, he used the flying missiles to bombard and wreck atoms of familiar substances, thus brooming the first hundred percent alchemist. By knocking atoms to pieces with the big guns of radium, he discovered the "proton," the atom's nucleus, that finally shattered the idea of an "indivisible atom."

Meanwhile Thomson actually weighed the electron by observing its swerving flight on an electric tube. And Rutherford showed with his exploding radium atoms that all electrons within atoms must be whirling so rapidly as to reach, at times, velocities as high as ninety-three thousand miles a second—half the speed of light itself! They must spin in orbits around the nucleus, like satellites, since otherwise they would fall into it, as the earth would fall into the sun, and the atom would be annihilated when its electric charges neutralized each other.

FROM this brilliant work and his own as well, Niels Bohr harmonized all existing discoveries in one masterly mathematical explanation of the whole structure of atoms—the conception that with few changes is now accepted. Millikan and others helped prove Bohr's conclusion that all atoms, like those Rutherford observed, are built of positively electrified "protons" with negatively electrified "electrons" whirling about them, and that the number alone determines whether the atom is of iron, phosphorus, or sodium. For many years it was believed that every element was distinct, unique, like nothing else on earth. Now we know that all the elements are second cousins to each other, differing only in the number of the particles of which they are made.

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Fontaine Fox Insists He Is an Inventor

(Continued from page 11)

which the Skipper could measure the depth of the water in front of him without leaving his platform and before disaster had overtaken the car. That was comparatively simple and immensely valuable, but I've never seen it in operation. I showed the measuring rod, properly graduated, set at right angles from a long pole designed to be an extension of the Skipper's arm.

I cite as additional proof of the mechanical bent of my mind another drawing in which I had the Skipper salvaging the head board of an old iron bed from the Tonnerville dump in order to give his car a fender.

IT WAS just a comic drawing when I made a picture of the Skipper with a runaway car wheel socketed in an old lawn mower handle and had him explaining to a flabbergasted passenger that "these here car wheels are a ding sight heavier than they look." In many American factories the workman who proposed such a simple labor-saving device would be rewarded with a bonus. Another device evolved by me, to save the Skipper the trouble of stopping the car during slippery weather and walking ahead to throw ashes on the rails, was just as definitely an invention as the first crooked stick used by some primitive men to break the soil was the invention of the plow. I worked out a wooden tongue with a cross arm, at each end of which was suspended a coal hod. Reins held in the Skipper's hands enabled him to throw ashes and cinders on the rails. No one has offered to pay me any royalties on that one, but I did receive an offer from a manufacturer for a device of mine which appeared in a drawing made some years ago. This showed a commuter who had litted an electric torch into the handle of his umbrella so that he could keep out of mud puddles and have one hand free on many nights to manage his bundles. These are being made and sold today, but I have not troubled to find out if the manufacturer is the one who wrote to me. If he is he owes me a dozen umbrellas.

I DO not mean to boast, but I am willing to undertake to solve any minor domestic problem with a workable contrivance of my own invention. One of our neighbors had a stupid nursemaid who somet times tipped their baby out of its cart by pushing it into ditches while absent-mindedly looking over her shoulder at the lane some toe man. I drew a cartoon which expounded the device the professor's wife had installed to compensate for his absent-mindedness when pushing the baby in its perambulator. A pole with a fork at the end projected from the chassis. Held in that fork was a weighted rod with a wheel at the lower end, rolling along as a leading fifth wheel until the professor, with his nose in a book, approached a curbstone or other sharp depression. Then the drop of the fifth wheel, without the slightest jar to the baby, gave a severe and admonitory yank to the thin arm of the professor by means of a rope attached to the upper end of the weighted rod and fed back to the professor's wrist over a trolley pole secured to the front of the baby carriage.

Day in and day out I am obliged to produce a comic drawing. In them I poke fun at my mechanical contrivances fashioned out of ordinary articles, such as a cake pan adjusted to Uncle Peleg's wooden leg to keep it from sinking into the snow, but down underneath I cherish a sense of kinship for all those inventors who file their discoveries at the patent office. Even if mine, instead of being patented, are copyrighted, still, as I said at the beginning, I am an inventor.



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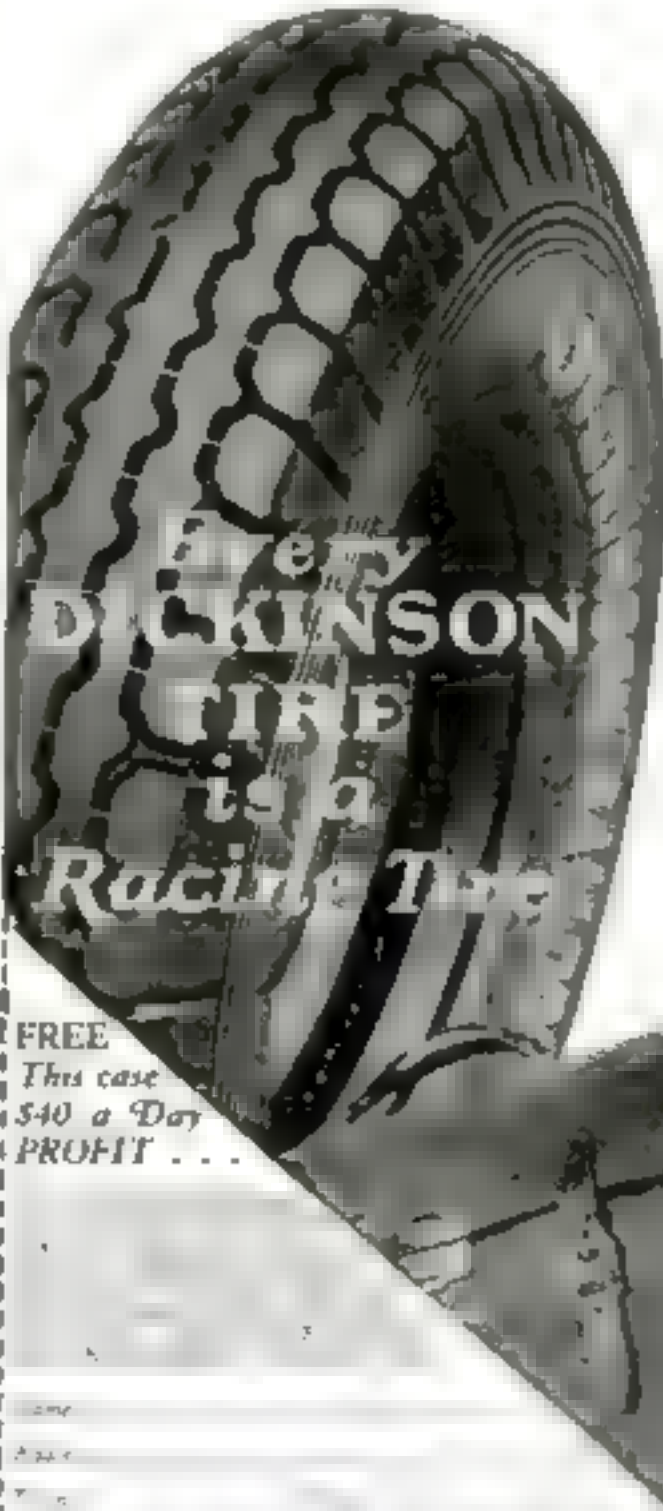
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"The Make Must Go On"

(Continued from page 140)

lived steadfast to the only creed he knew "Mr. Maroney," he said earnestly, "the make will go on."

From the locker bench the bright old eyes looked up at him.

"You're a good lad, Hunt. I remember ye stood with me. You'll go far and fast—you've got the learnin'—and the brains to use it. Still an' all, you have to do it—how else can ye be sure ye know?" The old man's jaw closed stubbornly. He rose. "I'll pay off Bonner and be gone. He's left Number One in bad shape. You'll be stayin' til she's on the main again?"

Dan nodded. Then hesitantly

"I'll go with you to the office?"

Maroney shook his head.

"No need. Steve Bonner—ah, it's just bad whiskey talkin'."

IT WAS close to midnight when big Tony Machek and his helpers drew the three-inch bull-bar from the clinker door of Number One and let it fall, its chisel point sputtering, white hot. As it hissed and crackled on the basement floor, the men drew back and with jumps of waste wiped away the sweat streaming in their eyes.

"Lotus clinker, Mr. Boss," said Tony.

Dan nodded.

"She'll do now, Tony. Close the doors, don't forget to dupe 'em."

Ed Nelson, the night foreman, hurried by through the shadowy basement.

"Ready?" the latter called anxiously. "We've got to get her on—they're pullin' us away from us tonight—holder's down to the first lift—lower as she's been for months."

The clang of the coal passers' scoops rang on the steel floor above him as Dan Hunt, beneath a light cluster, stopped and leafed through his note book to the page heading "Operation Data, Water Gas Machines." It was mostly data from an English textbook, supplemented by memos gathered at old Dinnis's school of "Doan's." He checked the list—but halfway down it Nelson again interrupted him.

"Dan, the thermocouple on the Number One pyrometer's burned out. You know where the spares are kept?"

THE gas-maker's helper was screwing down the collar bar above the domed charging door when he returned. The blast roared on and Dan perched himself upon the iron stairway railing for a rest. A long day—eighteen hours or thereabouts. Some job, this was! Yet, unaccountably, he felt a warmth surge through him as he watched the floormen moving steadily, methodically, about the huge machines.

"A man's job, anyway," he said, half aloud. The words recalled his superintendent. Again he saw the bent figure, fearless, confronting the insurrection in the locker room. Then to him came old Dinnis's words: "You'll stay with her til she's on the main again?" He slipped from the railing and moved out on the floor checking the lift of the air blast valves, the oil pressure, the heat which the pyrometers indicated, the water volume flowing through the seal pot. There was a lack of enthusiasm about it, though. His legs ached from much running up and down the steep iron stairs, his feet were battered by the hot floor plates, and his eyes smarted. He paused at the stairhead, glanced down again at his notebook and a sentence leaped out at him. "Inspect adjustment of explosion traps on air main. Every shift (Maroney)."

Ed Nelson shuffled up the stairs.

"We be on in half a minute. Time we was. Never seen a drag like this. Old man just telephoned. Told him everything was jake. He'd be wild if he saw that holder crowdin' down into the mud."

Dan shut the book.

(Continued on page 142)

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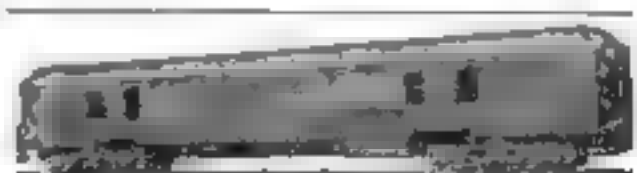
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"The Make Must Go On"

(Continued from page 142)

the open valve, jammed it down, and turning, met the charge of a sinister ghost that stole from the cloaking shadows.

Ed Nelson waked to action, snatched up a broken stud bolt and ran in just as Dan Hunt, with a choking gasp, sank to his knees. The foreman's arm descended swiftly, the shadow spun beneath the purple arc light, then collapsed, and the cruel face of Bonner stared up sightless in the flickering light.

In the gas works office Dinnie absently removed the jacket from a boiled potato and sprayed the tuber with a pinch of salt. The daily paper lay across his knees, and while he ate he spelled the news out laboriously, his lips moving to a soundless rhythm.

At length he paused, laid the remainder of his meal in the tin tray of his lunch box, and looked out in meditation through the window at a string of tank cars shunting noisily along the yard spur. His eyes swung back as Dan Hunt entered, and he stared for a long moment at the boy and the tight bandages about his head.

THEN, picking up the paper, he motioned for attention, set his silver spectacles and read aloud with painful effort:

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As the superintendent finished, he glanced at Dan again above the sheet. Crinkly lines radiated from his deep-set eyes, in his creamy beanie, he said:

"D-dry as dust. Ye spoiled a splendid story for the newspapers, Dan Hunt."

Television Brought into the Home

(Continued from page 91)


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When will the sets be ready to be marketed? "Reasonably soon," is all David Sarnoff, of the Radio Corporation of America, who saw the demonstration, will say. But he adds: "Within five years television will be an art and an industry."

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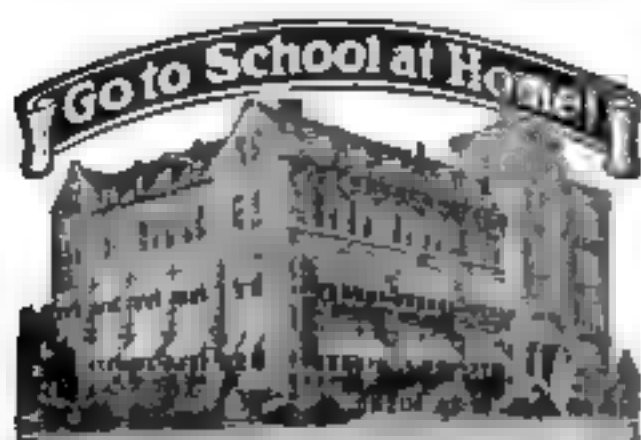
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The Movie Maker

(Continued from page 141)

ludicrously out of alignment by Jerry's misperception.

All of the action had to be taken within strictly defined limits—the central portion of the full-sized set—but once Jerry inadvertently stepped a little too far into the foreground. When this appeared on the screen, he suddenly shot up to giant height, his head apparently touching the ceiling beams. Again, in dodging a blow from one of the villain's henchmen, he swerved beyond the camera deadline at the right, and the upper part of his body, enlarged to huge proportions, pierced the wall of the room without damage to either

BUT these were minor difficulties, easily remedied by careful cutting and splicing. The picture was advancing steadily. Each night, after the others had gone home, Don spent an hour or more checking off the completed scenes and planning further details of his campaign, as a general moves up the pin soldiers on the battle line of a map. Other motion picture directors, spending unlimited company money, might afford to squander time and materials in producing a picture by the cut-and-try method, but Don was forced to substitute brains for dollars and forethought for footage. As the weeks passed, the young director grew leaner, his fighting jaw more prominent, and the race narrowed between the picture and the studio bigwigs overhead.

During the days that Don was working over other scenes and sequences, a certain portion of his time and attention, as well as a great deal of his energy, was devoted to coaching Mabel's acting. She had foresightfully taken a course in a motion picture "school" and was blantly certain that she was well equipped. And after seeing the first close-ups of herself, she went about in a happy trance. The fact that her face was absolutely devoid of expression was of little moment to her. She looked beautiful and that was sufficient. Don first worked alone with her and then called in other members of the cast to arouse some animation in that placid mask, but the very weight of Mabel's inertia wore them all out.

One evening during the third week of October, the five gathered at Margaret's home for dinner and a conference.

"IF YOU give Mabel plenty of long shots," Jerry demanded impatiently, "why bother with close-ups? You'll never get any real expression on that blank cartridge face in a million years."

"But she is the second lead, you know," commented Margaret, "and she looks very beautiful in the close-ups. Her face is strikingly unusual."

"Yes on the screen—since Menzies straightened her nose with charcoal," admitted Jerry. "That man is a wonder."

"Straightened her nose?" questioned the professor coming out of a brown study. "How could he do so remarkable an operation with charcoal? I have been too busy making models for the Alpine village to notice noses."

"But surely you've observed that her nose is rather thick and irregular, haven't you?" asked Jerry.

The professor nodded. "Well, Louis Menzies showed her how to shade it on each side with charcoal, then he put shadows entirely around her eyes, but left the lids white," explained Jerry enthusiastically. "And instead of trying to make her mouth look smaller, he accentuated the size of her lower lip by putting a small charcoal line right under the center of it. And now she looks like a big-eyed Greek goddess on the screen—beautiful classic nose, full round lips, noble brow—and just as dumb as a marble statue."

"But I believe she will really make a sensation," insisted (Continued on page 147)

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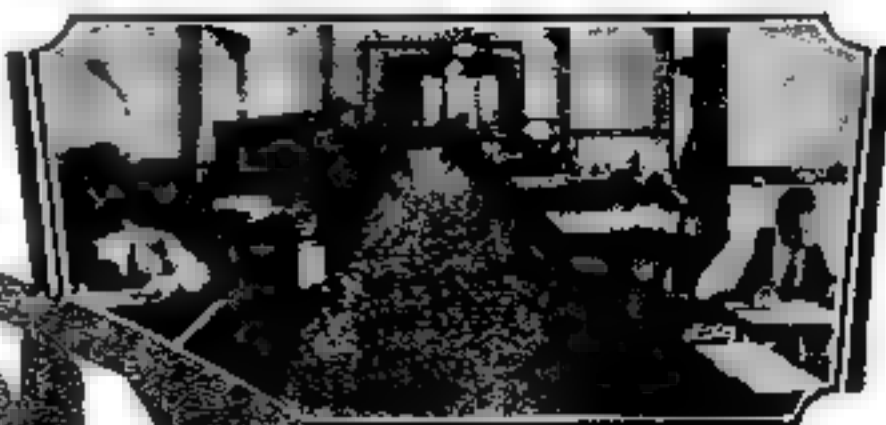
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The Movie Maker

(Continued from page 146)

planting trees, and putting in lake and river as they appeared on the reel and the still photographs Hoso had sent.

To get the complete long shots, as well as a double exposure series to be used later in combination with the full-sized village set, Don placed two cameras near the edge of the table on which the model was built, the lens of one being half masked. Then, while Tim and the second camera man turned the cranks, the professor slowly inundated the village. First, the landslide toppled into the miniature lake, then the water, trickling down the roadway, became a mighty torrent a moment after the cloudburst on the mountain tops. To produce the cloudburst, the professor operated a shower bath spray above the range of the cameras, while additional water, flowing more and more rapidly from a small hose which the professor held behind the top of a miniature mountain, rushed on toward the village. Tiny trees were swept away and miniature herds of goats and cattle were caught in the swirling flood.

BUT what was to be the real thrill of the sequence, when superimposed on the miniature flood scene, was taken on another part of the lot. There Mabel, urged on by the entire cast, extras and technical force, ran madly on an inclined treadmill against a blank white background. And Mabel had to run, for the treadmill was moving rapidly. Don had seen to that. The shots were made by a trucked-up camera, cranked as it was rolled slowly toward her from a distance of eighty feet to within eight feet.

At this point the camera man stopped grinding and a platform was hastily erected in front of and above the treadmill. A tank was hoisted upon the platform and filled with water from a fire hose. The sequence was finished with Tim cranking at double speed while two stage hands slowly tipped the tank and poured the water into a second tank below the camera angle.

As the curtain of water fell between the lens and Mabel, she gave a very good imitation of a young woman engulfed by a flood. Almost any agitated motions she might make were adequate, for reality was lent to the scene by a wind machine outside the camera deadline, which swirled her long hair across her face and made her vouchsafes sk its brow about her.

The treadmill had been stopped a moment after the stagehands began to pour the water. The final touch of realism was added when, as Mabel threw herself gracefully upon the incline, the treadmill was started very slowly and she rose out of the range of the camera, which was slowly being hauled away from her. This, Don felt, would give the appearance on the screen of Mabel rising to the top of the flood, while of course the high speed of the cranking would, on the screen, give a slow-motion effect very like the gently floating motion of a body in the water. At the same time the wind machine would give the effect of rushing waters sweeping Mabel's draperies and hair about her.

THE greatest excitement for members of the cast, however, and the most difficult task for Don, came in taking the closer shots of the flood. In the center of the Swiss village was a platform for dancing. There the villagers in their gay costumes were whirling to the music of lively folksongs played by an old fiddler, when Mabel, drenched and disheveled, burst into their midst to give the alarm.

Don directed the scene through a megaphone from a small platform built immediately in front of the set. With him on the platform were Tim and the second camera man. Two assistants and a third camera man worked from other angles, catching all the movement and gaiety of the scene—the dancers on the platform, the crusaders (Continued on page 148)

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"Can I Afford an Airplane?"

(Continued from page 154)

plane is not so hard. "I feel it is as easy to fly as it is to drive an automobile," he asserts. "My estimate is that it would take an ordinary individual about thirty minutes to learn how to fly, and probably six or seven hours to learn how to take-off and land. Perhaps with some of the modern ships, landing skill would be more quickly acquired."

"I do no stunt flying," he adds, "and stay on the ground in stormy or bad weather. I did attempt to fly in a fog early one morning in the hope that the fog would lift when the sun came up. Instead, it became thicker, and I lost my way even though I was flying only fifty feet from the ground. A railroad station set me right and I flew back to the field."

"From my experience," says a New York corporation executive who has piloted his own plane several thousand miles, "I can't see how any normal person of moderate means can refrain from purchasing his own ship after he has once experienced the delightful sensation of traveling by air."

"A GOOD plane in the hands of a competent pilot is an endless source of pleasure," declares James F. Hayden, of Sebring, Fla.

There are some qualifying voices. "I would like to give this advice to others," says one, "Own your own plane, but for God's sake be careful!"

"I would advise others to own and operate planes," says another, "but I believe that it should be qualified to this extent—that the man who is in a position to own and operate a four- or five-thousand dollar automobile is and should be the logical owner and user of an airplane. It is only in the near future, I believe, that we will all be able to own and operate light, economical airplanes. Milton C. Main, of Santa Cruz, Calif., okay's "safe, sane flying. No stunts."

"Some of my experiences favor, and some are decidedly against, the private ownership of planes," says Dr. R. B. Ferguson, a Chicago physician. "I used my plane for business and pleasure flying to a state medical meetings and to the American Medical Association meetings. I have the honor of being the first physician to fly to the Association's national meetings. I visited my family in distant cities, and attended national air races. In all, I had many hours of flying and considerable pleasure."

"Times have changed; hangar space is \$30 a month at the new municipal landing field, and mechanics' charges are too high for the average man to maintain a plane; especially when planes are not particularly practicable for everyday work. If prices were reasonable I would again have my own plane."

ONLY one pilot definitely advises against private flying. Paul E. Thomason, of Charlotte, N. C., says, "Not until flying fields are more plentiful."

On the other hand, from Oklahoma comes one pilot's report, "The topography of this state is such that landing fields are available at almost any town to which I may wish to go. Flying or driving is the only way to reach towns where railroad connections are poor."

There is the evidence. Much of it is in favor of private flying. It reveals, too, for the first time, just what the average flyer may expect to spend.

Some feel that flying is still too expensive for the man of average means. Those who have their own storage ground, who can be their own mechanics, are able to get off more inexpensively. But the small plane owner without these advantages, many say, may still afford to have his own plane and use it for pleasure.

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Here Are Correct Answers to Questions on Page 53

1. In 1703 Peter the Great of Russia decided to build himself a capital on the banks of the River Neva, shortly above where this river empties into the Gulf of Finland. The land was swamp. It was necessary to fill it in and to drive piles before the city of St. Petersburg could be built. This city is now known as Leningrad.

2. The great forest of the Amazon valley

3. Santo Domingo, in the West India, has a mountain peak, Loma Tina, that is more than 10,000 feet high. Just northeast of this island the depth of the Atlantic is 31,600 feet. Accordingly, the island really consists of a great volcanic mountain rising from the sea bottom to a height of nearly seven and a half miles, nearly two miles higher than the height above sea level of the world's greatest mountain, Everest.

4. This kind of house is used by the native Indians all over Mexico, but especially on the west coast. The climate of this country is mud all the year round. Accordingly, one side of the house is left out, leaving the rooms exposed to the open air.

5. It has been used recently in several surveying projects, but its chief successes have been in Alaska. In order to determine the longitude of a place, it formerly was necessary for the surveyor to carry an accurate chronometer, from which he knew the standard time. Nowadays, surveyors carry radio sets by which they pick up the extremely accurate time signals from some of the large radio stations, notably from the United States Government station at Arlington.

6. There is some question whether this distinction belongs to Louisiana or to Mississippi in both the annual rainfall is from fifty-five to sixty inches.

7. West of Death Valley are the high mountains of the Panamint Range. During the winter these mountains are snow-covered. It is an easy day's trip on horseback from the bottom of Death Valley, where even winter days are hot, up into the snow-covered ridges of the Panamints.

8. The great ape called the gorilla, the largest and strongest of all the apes, is a native of the equatorial part of Africa, including French Equatorial Africa and the Belgian Congo. Gorillas never were very plentiful and they are still less so now.

9. There has been an enormous amount of speculation concerning the whereabouts of the Jewish tribes who were driven out of the Holy Land and who disappeared from history. The most probable theory is that the tribes were dispersed into northern Syria and Asia Minor and were gradually absorbed into the other peoples there.

10. This is possible in the mountainous part of Kenya Colony, east of the great lake of Victoria Nyanza, now commonly called Lake Victoria, and in Tanganyika Colony, directly to the south. On the snow-clad slopes of the mountains residents of these colonies enjoy winter sports.

11. Mount Hood, in Oregon. A cap of cloud usually covers the mountain. It is said the fanciest resemblance of this cloud to a hood was what gave the mountain its name.

12. All along the Gulf Coast of the United States there are forests composed of the remarkable cypress tree. This tree lives very well with its roots covered more or less continuously by water.

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Plants That See, Feel and Think

(Continued from page 56)

and it is fortunate for her that the pens are not arranged in series!"

The reader and I do not know whether to smile with the scientist over the last sentence or to remain dully amazed over the main statement. It appears that a sack of pens contains the energy of a power house and could run a battleship, and a pocketful of pens could propel an automobile!

THE electric probe was devised by Sir Jagadis to locate the nerves and the pulsating heartlike cells of the plant. The probe consists of a wire point in circuit with a galvanometer and recording apparatus. When an electric contact is made with a resting muscle, the galvanometer remains quiescent, he says. "But if the contact be made with a beating heart, electric pulsations are generated corresponding to the mechanical pulsations. In locating the 'heart' I introduced the probe, step by step, into the organ, as soon as it came in contact with the pulsating layer, electric signals were sent out."

One contact is with a leaf, the other with the probe which enters the stem transversely at intervals of about one twenty-fifth of an inch. At this depth there is feeble pulsation. More happens at twice the depth. Then, at one-eighth inch, "the pulsations exhibited a sudden increase; this was so great that a part of the record went off the plate; evidently the probe had come into contact with pulsating cells. Beyond there was diminishing response. Dissection revealed the plant heart as being "the internal layer of the cortex abutting upon the young vascular tissue." The experimenter tried out the plant heart with chloroform, ether, cobra venom and other drugs and poisons, finding that it reacted in a manner similar to that of an animal heart.

THE most spectacular of the numerous devices invented by Sir Jagadis to help the plants tell their life secrets is the magnetic crescograph. This makes growth visible. An earlier model used levers to magnify growth ten thousand times; this was not enough and had the fault of mechanical clumsiness. In the new machine there is a single lever, the short arm of which is attached to the tip of a potted plant. The long arm is free and frictionless, but since it is a magnetized rod, its pointer end deflects a suspended magnetic needle which is attached to a tiny mirror. Growth lowers the long arm, the mirror tilts increasingly and reflects a beam of light that moves across a distant scale. Thus the movement of growth is magnified from ten to a hundred million times, according to the distance of the scale from the mirror. In fact, with this device it would be possible to show a plant growing faster than an airplane travels.

But there is enough thrill for layman or scientist to see "the indicating line of light rushing across a ten-foot scale in the course of some twelve seconds," when the plant has actually grown about 1/8,333 inch in that period, or at the rate of less than half an inch for the sunniest and longest summer day.

Safety Beacons in Streets

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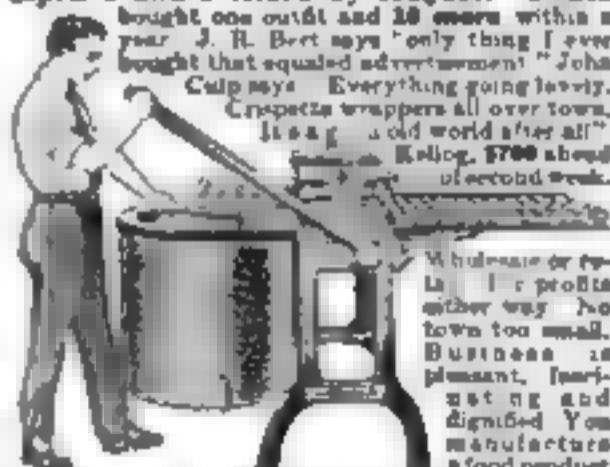
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Strange Radio Devices Locate Buried Treasure

(Continued from page 45)

quakes photographically. If a "salt dome"—a huge subterranean plug of rock salt and associated rocks that geologists have learned generally means a rich oil well near by—lies hidden in the path of the tremors, the seismographs will show it by their altered records. In a recent development of this process a pistol-shot a few feet below the earth's surface replaces the dynamite blast, and the transmission of the sound through the earth is listened to through earphones. This device, invented by Dr. Samuel Spitz and secretly used by the United States in another form during the war as a sounding device and submarine detector, is called a "petrosonometer" or oil-determiner, and with it, Dr. Spitz says, he has located during the last eighteen months nineteen producing wells and twelve or more separate oil pools.

W FIGHTING the underlying earth, to see if it contains oil—which is lighter than rock—and to aid the geologist in studying its structure, is the amazing feat performed by an inconceivably sensitive balance designed to measure the force of gravity at any point on the earth's surface. Each cubic foot of rock, ore, or coal exerts a gravitational pull in proportion to its weight, and the automatic balance invented by the European physicist, Baron von Eötvös, is therefore able to tell whether heavy rock or light oil is likely to lie beneath. So sensitive is the balance that any near-by trees, boulders, or ditches will hopelessly confuse the photographic measurements it makes.

It cannot be used in mountainous country, but in the flatter sections of Texas and Louisiana, the Eötvös torsion balance has located twenty-three "salt domes" in the last four years, ten of which have been proved by drilling. In the previous fifteen years, by way of comparison, geologists had been able to locate but six.

Each of the new prospecting methods has its own specific usefulness. Radio prospecting, for example, is limited to metal ores known as "sulphides," such as galena, which contains lead and sulphur in combination, zinc-blende, or zinc and sulphur; and other sulphur ores of such metals as silver and, occasionally, gold.

BUT there are still other electrical ways of finding ore. A sulphide ore deposit, it has been known for years, is really a great low-power storage battery. Its natural chemical action with surrounding substances in the earth, nature especially in copper sulphide deposits near Cornwall, England, maintains in it a flowing electric current about equal in power to one of the batteries that runs your flashlight. Professor Conrad Schlumberger, of the Paris School of Mines, and his brother Marcel devised a portable sensitive electric meter no larger than a cigar box that would detect such a current, now widely used on heavily timbered lands in the United States and abroad. Previously they had worked out successfully a scheme of shooting electricity through the earth to locate hidden ore by its lower resistance to the current's passage. This system is being used successfully in Canada.

Now that the oldest method of all, the magnetic compass needle—used as long ago as 1700, in New Jersey, to detect magnetic iron ore—has been brought up to date in the form of a highly sensitive "magnetometer" used today with great results in the iron areas of Lake Superior shores, the equipment of the modern prospector is complete. We can actually "see" underground, and predict and detect buried treasures at depths ranging from 100 to 500 feet. Though we cannot tell just how rich a hidden deposit will prove to be, we know at least where to dig.

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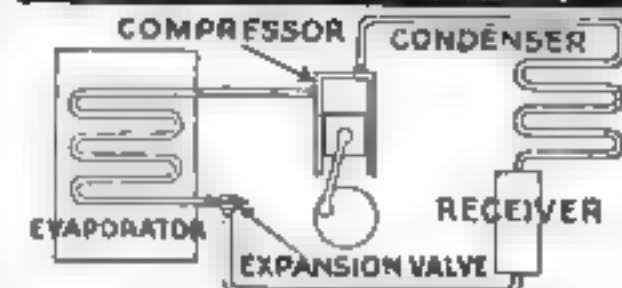
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